ASSOCIATION OF PUBLIC-SAFETY
COMMUNICATIONS OFFICIALS - INTERNATIONAL

AN ASSESSMENT OF THE VALUE OF LOCATION DATA DELIVERED TO PSAPS WITH ENHANCED WIRELESS 911 CALLS

PROJECT LOCATE

(LOCATE OUR CITIZENS AT TIMES OF EMERGENCY)

FINAL REPORT

APRIL 2007

PROJECT LOCATE

APCO INTERNATIONAL

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LETTER FROM THE PROJECT CHAIR

As Chair of APCO Project LOCATE (Locate Our Citizens At Times of Emergency), I am pleased to present to the Association of Public-Safety Communications Officials (APCO) International Board of Officers, the APCO Executive Council, and the APCO membership the Final Report of the LOCATE effort to Assess the Location Data delivered to the PSAP with Wireless Enhanced 911 (E911) calls on behalf of the Project LOCATE Team.

Using grant funding from the Public Safety Foundation of America (PSFA), tests were performed by an independent third-party contractor in seven Public Safety Answering Points (PSAPs) across the country. This collection of PSAPs offered a diversity of demographics and typography, and a variety of local exchange carriers, automatic location and number identification equipment, and computer aided dispatch (CAD) systems. The purpose of this assessment conducted by public safety was to gauge the value and usability of the wireless location data which was presented to calltakers with E911 calls requiring immediate assistance. Project LOCATE believes this endeavor has produced significant information about the actual performance of the enhanced wireless systems deployed which has general impact on both deployment and quality assurance efforts by PSAPs across the country. In addition, the Project LOCATE grant activity demonstrated an urgent need to reconcile the expectations regarding perceived capability that the public and response agencies have with the more modest reality of current performance and capacity.

Project LOCATE and the wireless service providers (WSPs) serving each PSAP Test Area met often to discuss the testing results, trends, anomalies and to analyze the actual performance in light of the expectations of the public and the "common consumer-type experience." It is from these discussions with the WSPs that majority consensus was reached on many of the jointly developed Effective Practices (EPs), which are included in this Final Report. The benefits, both present and future, of the partnership developed with the WSPs demonstrate the value of having every PSAP Manager become more aware of the dynamics associated with wireless Phase II deployment and call delivery as well as embrace, to whatever degree is feasible, an effective working relationship with the WSPs in their service area.

Overall, systems, as tested, did not perform as well as Project LOCATE had anticipated. While the FCC accuracy parameters are not currently applicable at the PSAP level, using them as a reference allowed a point of comparison for the consistency and usefulness of location data delivered on E911 calls to the selected PSAPs. How these systems actually performed was an important learning experience that had not been widely available. At the PSAP, the recognition of the degree of deviation associated with wireless location data has impact on call processing as well as dispatch capability. The degree of deviation must be understood per WSP in order to establish and assess actual capability within any service area. Since both the public and First Responders have relied on the wireless location data for dispatch, this varied capability of the technology should be shared with the public and First Responders for more efficient call management and response. At one specific PSAP Test Area, supplemental testing, conducted after discussion with the WSPs, using a modified test plan developed with the WSP's input also produced somewhat improved results, although the results were still less than expected.

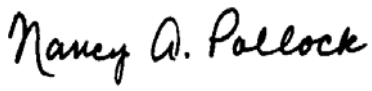
Finally, as a deliverable of this PSFA grant, public safety is now in possession of actual wireless E911 performance data, albeit a "snapshot in time only" of the deployed systems within each PSAP test area. The public belief that the ability to speak to a calltaker guarantees that useful location information is always present for dispatch purposes cannot be supported by the test results. The test

project initiated meaningful discussions and multiple meetings with WSPs regarding ways to improve the usefulness and consistency of the location data delivered to the PSAP. The February draft report was reviewed and discussed with the WSPs and the Project LOCATE team considered feedback and sought to clarify portions of the text within this report.

Thanks to the PSFA Board of Directors who shared the vision of Project LOCATE and provided the financial support to obtain the results necessary to educate our membership and the public on the performance of wireless location data.

A special thank you to the PSAP Test Area Managers for their cooperation and patience.
Thanks also to the Project LOCATE Team members whose dedication and focused efforts put forth in this multi-year project has been inspiring. They consistently sought to achieve the highest standards for improving location accuracy delivered to the PSAP and the concrete data necessary to develop the effective practices which will be helpful across our industry. They never wavered in their resolve to seek clarity in understanding and improvement in location accuracy delivered to the PSAP because of the importance it holds to how we do our jobs effectively for the safety of the public we serve.

Finally, a very sincere thank you and immense gratitude to the APCO Staff. Without their consistent and steady drive toward the mission, we would not have been able to achieve this final report and documented lessons for public safety managers across the country. The APCO membership is truly fortunate to have such dedicated individuals working on their behalf.



Nancy A. Pollock
Chair
APCO Project LOCATE

Dear Colleagues:

In August 2005, the Board of Directors of the Public Safety Foundation of America (PSFA) awarded a grant to Project LOCATE to conduct independent testing of wireless location data delivered to Public Safety Answering Points (PSAPs). Project LOCATE's assessment of the wireless location data delivered to the PSAP was conducted in a manner consistent with the published Federal Communications Commission (FCC) guidelines. It was the first public safety review of wireless enhanced 911 (E911) system performance conducted at selected sites, representing a wide variety of topography and demographics across the country. The goal of the testing was to assess overall wireless system performance and the operational impact on PSAPs. Some of the issues the testing, data evaluation and wireless service provider (WSP) partnership addressed included:

- The value of the location data in terms of prompt, effective dispatch of the appropriate emergency services;
- The variables that contribute to the quality of the wireless location data presented to a PSAP when emergency calls are made from wireless devices;
- The lessons that have been learned since the deployment of Phase II wireless enhanced 911 and;
- The best practices that can be adopted to improve the effective deployment and performance monitoring of Phase II wireless enhanced 911, as well as the processing of per call wireless location data at the PSAP.

A very positive result of this project was the meaningful working partnership between APCO International, the PSAPs and the WSPs in a joint effort to improve the performance and managing the expectations about response to emergency calls from wireless telephones. Certainly, differences among the parties exist; however, the effort demonstrated by Project LOCATE showed that public safety and the WSPs share a common responsibility to improve location data delivered to the PSAP.

The Effective Practices derived from this intense effort have significant value to PSAPs, as well as executive-level decision makers. The commitment to seek wireless deployment requires project management capability, as well as clear expectations about actual timelines and costs.

The development of equipment and software interfaces should be well understood and managed properly. The role of each partner in the effort to improve public safety services to wireless E911 callers must be recognized and executed appropriately. Local efforts to assess the performance of current and developing systems are critical to better understanding the wireless location data delivered to PSAPs. There is a continued need for education and awareness for responders, PSAP staff, and public expectations of public safety.

The APCO Project LOCATE Team has done a tremendous service to public safety through this effort. This work will continue as systems evolve and the ever-increasing number of wireless 911

calls becomes the dominant source of access to emergency services in many locations across the country.

Cordially,

Wanda McCarley
President
APCO International

The prompt and effective dispatch of appropriate emergency services to any reported event is dependent upon obtaining the best location information possible from the caller. This essential element of competent dispatching must occur regardless of the technology type used to access the universal emergency number, 911. The national effort to resolve technical and operational issues raised by public safety was recognized by the Federal Communications Commission (FCC). The detailed history to meet service equivalency expectations of the public between wire line and wireless telephones, when accessing emergency services, is well documented within FCC Docket Number 94-102 and its subsequent Orders. In addition, the Network Reliability and Interoperability Council (NRIC VII) sought to supplement the record with subgroups dedicated to the issues surrounding the quality of location accuracy delivered to the Public Safety Answering Points (PSAPs) across the country.

Since 1996, the FCC has taken action to improve the quality and reliability of 911 emergency services for wireless telephone users by adopting rules to govern the availability of basic 911 services and the implementation of Wireless Enhanced 911 (E911) for wireless services. The FCC's wireless 911 rulings seek to improve the reliability of E911 services and to provide emergency services personnel with wireless location data that will enable them to locate and provide assistance to wireless E911 callers more quickly. To further these goals, the agency has required wireless service providers (WSPs) to implement E911 service, subject to certain conditions and schedules. The FCC's wireless 911 rules apply to all cellular licensees, broadband Personal Communications Service (PCS) licensees and certain Specialized Mobile Radio (SMR) licensees.

The basic 911 rules require WSPs to transmit all 911 calls to a PSAP without regard to validation procedures intended to identify and intercept calls from non-subscribers. Therefore, under the rules both subscribers and non-subscribers (non-initialized wireless telephones) can dial 911 and reach emergency assistance providers without having to prove their subscription status. Public safety has gained significant experience regarding the impact of non-initialized wireless telephone units used by domestic abuse victims and other groups who have a demonstrated need to access 911 promptly.[1]

Many wireless 911 calls are made by good Samaritans reporting traffic accidents, crimes or other emergencies. Prompt delivery of these and other wireless 911 calls to public safety organizations benefits the public-at-large by promoting safety of life and property. In addition, recent U.S. Department of Homeland Security (DHS) grants to the American Trucking Association (ATA) have sought to expand the "surveillance and awareness" capability of these informed users of the national highway system by reporting suspicious persons and activity through wireless access to 911. Unfortunately, not every wireless 911 caller can adequately describe the location of the event, often leading to delayed responses and in rare cases, no response at all. The impact upon public safety agencies searching for such an ill-defined location results in loss of time, unavailability of emergency responders for other calls, as well as increased operational expense.

The FCC adopted additional requirements in May 1999 to improve the ability of wireless telephone users to complete wireless 911 calls. The 911 call-completion rules are intended to improve the security and safety of analog cellular users, especially in rural and suburban areas.

Under these rules, all wireless telephones manufactured for sale in the United States after February 13, 2000, capable of operating in an analog mode, including dual-mode and multi-mode, must

[1] FCC Website Search www.fcc.gov

include a special method for processing 911 calls. When a 911 call is made, the wireless telephone must override any programming that determines the handling of ordinary calls and must permit the call to be handled by any available WSP, regardless of whether the WSP is the customer's preferred WSP. Wireless telephones capable of operating in analog mode must incorporate any one or more of the 911 call-system-selection processes endorsed or approved by the commission.

Phase I wireless 911 service was defined by the FCC with a requirement that as of April 1, 1998, or within six months of a request by the designated PSAP, whichever is later, covered WSPs must provide the PSAP the telephone number of the originator of a 911 call and the location of the cell site or base station receiving a 911 call. This information assists in the provision of timely emergency responses, both by providing some information about the general location from which the call is being received and by permitting calltakers to re-establish a connection with the caller if the call is disconnected.

The Phase II Wireless E911 Requirements, as ordered by the FCC, included the provision of Automatic Location Identification (ALI) as part of Phase II wireless E911 implementation beginning October 1, 2001, as detailed below. Originally, the FCC's rules envisioned that WSPs would need to deploy network-based technologies to provide ALI. Subsequently there have been significant advances in location technologies that employ new or upgraded wireless telephones. In September 1999, the FCC revised its rules to better enable WSPs to use handset-based location technologies to meet the Phase II wireless E911 requirements. In particular, the FCC established separate accuracy requirements and deployment schedules for network-based and handset-based technologies. In August 2000, the FCC made minor adjustments to the deployment schedule for handset-based technologies.

For the purposes of ALI Accuracy Standards, the FCC adopted the following revised standards for Phase II wireless E911 location accuracy and reliability:

- For handset-based solutions: 50 meters for 67 percent of calls, 150 meters for 95 percent of calls and;
- For network-based solutions: 100 meters for 67 percent of calls, 300 meters for 95 percent of calls.

The FCC further required WSPs to report their plans for implementing Phase II wireless E911, including the technology they plan to use to provide wireless location data by November 9, 2000. This report was aimed at providing information to permit planning for Phase II wireless E911 implementation by public safety organizations, equipment manufacturers, local exchange carriers and the FCC, in order to support wireless Phase II deployment by October 1, 2001.[2]

The Phase I wireless E911 requirements, as well as certain of the Phase II wireless E911 requirements, are applicable to WSPs only if the administrator of the designated PSAP has requested the service and is capable of receiving and utilizing information provided. In November 1999, the FCC revised its E911 rules to remove the prerequisite that a cost-recovery mechanism for WSPs be in place before WSPs are obligated to provide wireless E911 service, in response to a PSAP request; however, in order to make a valid request for wireless E911 service, the PSAP must have the means to cover the costs of receiving and utilizing the ALI information. The FCC's rules do not mandate

[2] Ibid

any specific state action nor specify any particular mechanism for funding the technology and service capabilities necessary to enable the PSAP to make a valid service request.

The Communications and Public Safety Act of 1999, enacted October 29, 1999, was the topic of further orders by the FCC. In August 2000, the FCC adopted an order to implement the Wireless Communications and Public Safety Act of 1999 (911 Act). The purpose of the 911 Act is to enhance public safety by encouraging and facilitating the prompt deployment of a nationwide, seamless communications infrastructure for emergency services that includes wireless communications. The FCC initiated the implementation proceeding to address the provisions of the 911 Act and to fulfill the Congressional mandates set forth therein. Specifically, in the order adopted in August 2000, the FCC took the following initiatives:

- Designated 911 as the universal emergency telephone number within the United States for reporting an emergency to appropriate authorities and requesting assistance, effective August 29, 2000;

- Sought comment on appropriate transition periods for areas in which 911 is not currently in use as an emergency number, as well as on service-area-specific circumstances and capabilities that must be addressed before WSPs can deploy 911 as the uniform emergency number and;

- Sought comment on how the FCC should facilitate states' efforts to deploy comprehensive emergency communications systems (i.e., through guidelines, meetings, or other information-sharing measures in a manner that does not impose obligations or costs on any person).[3]

The Association of Public-Safety Communications Officials (APCO) International was both a participant and monitor of this evolving effort on behalf of the thousands of PSAPs serving the wireless telephone user seeking assistance in times of crisis. From the beginning, public safety recognized the challenges presented by wireless E911 calls to PSAPs which lacked useful location information.

MISSION AND SCOPE OF THE PROJECT

APCO Project LOCATE (Locate Our Citizens At Times of Emergency) is committed to supporting deployment of wireless E911 service at every PSAP providing 911 services today. The work of Project LOCATE seeks to enhance the ability of all PSAPs to effectively receive and process wireless E911 calls for service and to reduce the delay in and possible denial of prompt dispatch of appropriate emergency services to those in crisis.

Project LOCATE, with a grant from the Public Safety Foundation of America (PSFA), coordinated the testing which developed a sample of wireless location data accuracy, as delivered to selected PSAPs. This was accomplished by contracting with and managing independent third-party testing, consistent with the FCC Office of Engineering and Technology Bulletin Number 71, while maintaining awareness of the wireless industry created ATIS 0500001 methodology.

[3] Ibid

There has been and continues to be a clear public expectation that the PSAP, as well as response agencies, will have consistent and accurate wireless location data delivered with all wireless E911 calls to the PSAP. The consumers of wireless service have embraced the convenience of service equivalency for voice communication and have made assumptions, many of which are incorrect, about the capability of these devices to deliver wireless location data that can effectively assist the PSAP in the dispatch of emergency services, amidst a crisis event. Many callers are able to speak and upon interview by the calltaker, general location information can usually be determined; however, in the instances the caller cannot speak, or is too young or impaired to speak clearly and effectively, meaningful information about their location is absent. In these cases, the usefulness of the wireless data associated with the calls becomes the critical means to assess which resources are to be dispatched. Every consumer should know that calls without adequate location data for dispatch purposes will take longer to process, leading to an extended response time from initial contact with the PSAP and, in some cases, no response until another source of location information is provided. It is clear to PSAPs across the country that callers expect the PSAP to "know my location" during a crisis. Indeed, there is little time during the call for help for the calltaker to explain accuracy compliance and testing issues. Public safety resources that may be dispatched to events with uncertain location information are essentially out-of-service during the time of the response and search for the reported event. The resultant loss of availability for other reported emergencies, turnkey costs of such responses, and general risk to public safety practitioners in response mode are collateral consequences of less-than-useful and consistent location data.

Project LOCATE believes the public has an expectation that wireless E911 will perform the same as enhanced wire line 911; therefore, effective wireless Phase II deployment should include both the service equivalency of access (voice) and the service equivalency of location information (data) to PSAPs. Meeting this public expectation is recognized as a challenge however improvements of system performance at the PSAP level are possible and should be required.

Managing the expectations of PSAP staff, First Responders and the Public regarding the actual performance capability of wireless E911 systems as deployed across the nation will continue to require local action. At a minimum, every PSAP should seek to assess the actual performance of the current systems and assist consumers within the service area, to best utilize their wireless E911 access in times of crisis. The cost to test PSAP by PSAP is high; however, local agencies, in an effort to process calls for service in the most expedient and effective manner possible, find themselves in a situation which may require them to expend significant funds out of their already constrained public safety budgets in order to assess the usefulness of the data they receive on wireless calls.

Truly effective wireless deployment, which creates the assumption of service equivalency of access to emergency services, will continue to require accurate wireless location data, as defined in FCC Docket Number 94-102, as amended. The standard of location accuracy established by the FCC, as defined in FCC Docket Number 94-102, as amended, is not measured at the PSAP level by the WSP nor is it required under a current FCC consent decree (FCC 02 132 dated May 2, 2002 of Adoption of the Consent Decree network wide accuracy numbers from a set of test data weighted in accordance with OET 71 Bulletin No. 71.). Furthermore, the vast majority of PSAPs often have no means to assess and make adjustments for what should have been known as the location accuracy deviation per PSAP based on credible performance testing.

Project LOCATE specifically sought to move beyond the anecdotal reports and infrequently documented issues regarding the consistency and accuracy of wireless location data provided with Phase II wireless enhanced 911 calls. The selection of diverse wireless Phase II deployment sites to be tested, the first independent assessment, reflecting real life, common consumer experience, was made possible with a grant from the PSFA. The testing provided valuable lessons for public safety,

WSPs and legislative/regulatory bodies. A number of variables were considered to maximize the value of the testing process and results.

Project LOCATE fully understands and acknowledges that even this ambitious testing, is in fact, only a "snapshot" of system performance across a diverse set of PSAP Test Areas on the days of the actual testing; however, the results are quantifiable and within the control of public safety for such deployment, problem resolution partnership and public policy purposes that arise from it.

APCO, through Project LOCATE, is committed to helping PSAPs determine and understand what information they get with the wireless E911 call and to seek ways to improve the information received at the local level. Because WSPs are not required to report accuracy performance at the local PSAP level, APCO, on behalf of 15,000 public safety members across the country undertook a testing endeavor that cost our organization over $820,000 and immeasurable volunteer and staff time. APCO believed the testing effort was our responsibility to help public safety understand the performance of wireless systems and wireless location data delivered with wireless E911 calls, especially for those of our members who are not in a financial position to conduct such testing individually. One goal of Project LOCATE continues to be to understand the usefulness of the wireless location data for effective response to emergency requests by the calling public.

Project LOCATE also recognizes the immediate need for the public, the PSAPs and the field agencies to better understand the capability and limitations of this technology. There is clearly an essential obligation to expand public education in order to manage expectations that are simply not met by the technology, as deployed in some locations. Finally, the managed approach to both consistent and more accurate wireless location data received at the PSAP must include a positive partnership with WSPs.

Project LOCATE has implemented strict controls on the initial and supplemental test data. The sharing of the wireless location data accuracy test results delivered to the PSAPs through its independent third-party contractor was coordinated with the project's goals and objectives. Unfortunately, test data from initial, maintenance and other accuracy testing efforts of the WSPs has not been provided to the PSAP for review or discussion in the past. The public has had no opportunity to evaluate the accuracy of the location data derived through the deployed system of their WSP. Many wireless users recall the wire line 911 service at their home, which translates the assigned telephone number to a unique, physical address. Absent any clear disclosure to the contrary, it is understandable that consumers would believe that the same is true for wireless telephone calls for assistance.

Project LOCATE has provided direct assistance to the PSAP, governing organization, Authorities Having Jurisdiction (AHJ) and others in the interpretation and use of the test data, as summarized. This opportunity to work with PSAPs to better understand what data they do receive and the many variables which can contribute to its usefulness have been of great value to the individual PSAP and APCO membership in general.

In addition, understanding the data and the deployment in place by each WSP is critical and greatly improves the ability of the PSAP to identify issues, as well as potential solutions for both the short and long term. Project LOCATE has steadfastly urged PSAPs to be smart users of the deployed system, to understand what is being delivered and make the necessary, even if difficult, adjustments to expedite dispatch of emergency resources.

As a result of this grant funded activity, Project LOCATE can provide PSAP Managers with actual data and examples of such for informational purposes for inclusion within reports and presentations to executive decision-makers regarding the need for local improvements, as well as continuing

dialogue with WSPs. The collateral benefit of this action is to be able to assist first responders in recognizing the issues which impact the accuracy of wireless location data received at the PSAP on any call.

The entire public safety community and those served each day by them are potentially affected by the effort to improve the consistency and accuracy of wireless location data at the PSAP. Project LOCATE recognizes the need to manage current expectations among all users and responders. The success of such efforts can be measured in part by the improvement in understanding of current system capabilities. Support for public safety action to achieve significant performance enhancements leads to better consistency and accuracy of wireless location data delivered on every call to the PSAP.

This Project LOCATE Final Report offers PSAPs and others a number of effective practices (EPs), perhaps the most critical and important element to public safety as a result of this testing effort. A full review of these EPs was conducted with the WSP representatives, a small number were deemed to need more information or clarification. The remaining EPs, to which no comments or objections were made, are believed to be held in agreement between the parties. These practices are those demonstrated to add value to system deployment and upgrades within service areas. It has been the findings of Project LOCATE that partnership with all WSPs involved is critical to timely deployment, implementation and accurate delivery of wireless E911 information.

Project LOCATE continues its work to have effective practices fully endorsed by all the WSPs involved in the nationwide data assessment activity. This uniform approach to local issues reduces the need to adjust operations and service expectations by specific WSPs within the PSAP service area.

SELECTION OF PSAP TEST AREAS

Project LOCATE sought to identify representative PSAPs across the country that could serve as Project LOCATE PSAP Test Areas for the assessment of wireless location data accuracy delivered to the PSAP. In response to statements made within other forums regarding the potential for misrepresentation of wireless location data at the PSAP due to data translation of system subsets not under the control of the WSP, Project LOCATE sought to include multiple variables which are related to the quality of initial deployment, as well as the final data display at the PSAP receiving the wireless 911 call in times of crisis. In order to be considered as a PSAP Test Area for the initial project sponsored testing, the PSAP Manager/Executive had to verify and agree, in writing, to the following conditions:

- If selected, the PSAP staff, management, executive and political leadership agree not to offer/participate in/respond to any media interactions prior to the review of the initial data with the Project LOCATE Team;

- The PSAP has obtained and verified that their executive-level management has approved their participation in this testing project and that all such records, reports, and results are open and usable by Project LOCATE for training, educational, regulatory, and legislative purposes;

- The PSAP and its executive management agree not to disclose any results until full analysis of all test data and processes has been finally completed and released by Project LOCATE;

- The PSAP has successfully been deployed at the wireless Phase II level of service for more than six months, with multiple WSPs;

- The PSAP is the primary PSAP for wireless 911 calls within the test area;

- The PSAP has Phase II wireless E911 service from any combination of Tier 1, Tier II, Tier III WSPs, but no less than a total of three deployed WSPs;

- The PSAP can provide a shapefile in electronic form describing the service area from which wireless telephone calls are received. Service area maps with current and accurate cell sites/tower sectors are required, electronic formats are preferred;

- The PSAP can provide total 911 call volume, number and percent of which is wireless. If possible, wireless call volume by time of day, day of week, etc. Any PSAP level determination of call location source such as indoor/outdoor, WSP, call peak hours, etc., is welcome;

- The PSAP can identify any special features within the test area impacting wireless call volume or use on a regular basis (i.e., campuses, recreational sites, special events);

- The PSAP is willing to participate in this testing program, including committing adequate staff to the test call activity;

- The PSAP has the capability to record the calls, create records of such calls, and verify with normal wireless call processing mapping capability, the reported location of the caller, including "rebid" or "re-query;"

- All of such records shall be open to the Project LOCATE Team during this process and for subsequent analysis and reporting and;

- The PSAP can verify that no known network, Customer Premise Equipment (CPE), Computer Aided Dispatch (CAD) or mapping problem exists which would likely distort, modify, or delete wireless location data from being received and viewed at the PSAP.

Project LOCATE also required that each potential PSAP Test Area complete a PSAP specific survey instrument, which included:

- Name of Agency

- Address of Offices/Test Area Sites (if different)

- Contact Person

- Work telephone number

- Alternate telephone number

- Service Population

- Average shift staffing

- 911 System Service Provider
- CPE
- Telephony
- CAD
- Mapping Utilization Solution
- Average annual 911 Calls and percent wireless
- Current WSPs
- Maps of all cell sites known to contribute to wireless call volume (electronic and/or otherwise known cell sites, cell sites with sectors, etc.)
- Current assessment of accuracy from wireless devices as provided

As Project LOCATE sought to further refine the PSAP Test Area candidates, each were requested to provide the following additional information to allow final selection to be based upon the greatest number of variables:

- Number of full time employees (FTEs)[4] = Small 1-25 Medium 26-74 Large 75+
- Primary Rural Environment is Rural, Suburban, Urban
- PSAP environment has campus, industrial complex, recreational/sports facilities
- Successfully deployed wireless Phase II with three or more Tier One WSPs
- Successfully deployed wireless Phase II with two or more Tier I, Tier II, Tier III WSPs
- Deployment involved TeleCommunications Systems Inc. (TCS) as third party entity
- Deployment involved Intrado as third party entity
- Deployment included cost recovery for PSAP and/or WSPs
- Deployment included no cost recovery for either primary party
- Deployment include a migration to cost recovery during implementation
- Deployment included the use of an integrator or consultant to manage the project

This selection effort provided Project LOCATE with final sites that allowed the testing plan to replicate average consumer expectation and use with locally available WSP-specific wireless telephone

[4] Full Time Equivalent

models which delivered wireless location data via multiple 911 System Service Providers, different WSPs' Third Party Providers, diverse CPEs, different CAD systems and alternate mapping software choices. These variables were further enhanced by consideration of PSAP size, daily service population and area in square miles, multiple terrain types and demographics, state or central wireless coordination and cost recovery status.

The seven sites selected for the initial phase of wireless location data accuracy as delivered to the PSAP were:

- City of Palo Alto, California
- Marion County, Florida
- Jasper County, Missouri
- Onondaga County, New York
- Rowan County, North Carolina
- Bexar County, Texas
- City of Laramie, Wyoming

The PSAP management team and staff at each of these sites were genuinely interested in participating with the understanding that this testing effort was the first of its kind conducted across the country.

The Project LOCATE Team acknowledges the PSAP professionals' attention to the necessary preparations and call-handing during the multiple days of field testing in each PSAP Test Area and would like to thank them for their cooperation and assistance.

See Appendix C002 for further details of PSAP test areas.

TESTING PROTOCOLS AND SUMMARY OF INITIAL RESULTS

The testing protocol authorized by Project LOCATE for each PSAP Test Area followed the same basic process and parameters. A Test Plan was developed per site, which was designed to achieve a 90 percent confidence level, +/- three percent margin of error, using Ordered Statistics, as defined within FCC Office of Engineering and Technology Bulletin 71 (OET 71). There was not any weighting of test points or results. A total of 203 test points per PSAP Test Area were randomly created with 10 percent consisting of In-Building tests. The testing protocol required that a Wireless Accuracy Testing System, as well as Data Collection Units, be deployed during the tests. Ground truth per test point was established and data actually sent and received at the PSAP was automatically collected in addition to the contact with the on-duty calltaker. This dynamic was generally in place for 203 calls per WSP deployed system tested, per site. During some initial testing efforts, the test point was at a location from which "No Service" from the WSP was available. Project LOCATE further required that in order to best mirror consumer use and expectation for assistance during times of emergencies, random points could be used anywhere within the PSAP Service area at which service was available from the WSP which allowed a voice call to be completed. The wireless telephones

used in each test area were also to be commonly available in the PSAP Service Area. Special telephones, external antennae, battery boosters or special calling conditions were not used at the selected test points. In order to more closely duplicate the consumer experience, advance notice was not provided to any WSP.

The production of WSP reports per test area was completed according to the terms of the contract between APCO, Project LOCATE and the independent third-party contractor. The initial test protocols captured the wireless location data delivered to the PSAP when and if, the first occurrence of Class of Service (COS), Phase II wireless E911 was displayed, as was pre-Report general practice at most PSAPs. The assessment of the delivered wireless location data was based upon the array of data which demonstrated the specific results which produced the location errors as defined per location technology (Network/Handheld Solution-GPS/AGPS). The Project LOCATE effort sought to identify at what point and percentage of the time (consistency) did each WSP actually deliver to the PSAP and the accuracy in the range defined as the parameters of each location solution (accuracy). It is recognized that at present, the FCC parameters for accuracy and consistency are not measured at the PSAP, but rather the entire WSP network with weighting allowed. This current regulatory permission, while understood, does not diminish the value of the parameters at the PSAP level for the purposes of determining how local systems actually perform and to what degree consumers and the PSAP can rely upon the wireless location data.

A single report per WSP for each PSAP Test Area in which the WSP provided service was created by Project LOCATE and is provided here as a summary of the results of the initial testing experience. The per PSAP Test Area results were shared with WSPs individually, discussions of testing methodology, location of test call within the Test Area and re-bid dynamics were included. The name of the WSP has been changed to a code number on these reports.

In addition, the reports identified and tabulated the COS reported with each successful call to the PSAP, which presents an alternate view of the same call data. It should be noted that despite the efforts of all the parties, some of the wireless 911 test calls arrived at a PSAP other than the one designated as primary for the PSAP Test Area. These calls are designated as "Non-Target PSAP" calls and often affect the routing decisions based upon which tower took the call and not always from the choices made by the Primary PSAP.

The COS for this initial testing effort was usually defined as:

- WPH2 – a call that provides latitude and longitude location coordinates of the wireless E911 caller's wireless telephone;
- WPH1 — a call that provides the location of the cell site serving the wireless E911 caller's call;
- WRLS – a call that usually provides no location coordinates. This type of call is also referred to as a Phase 0 call, unless coordinates of the sector or cell site are provided.

It was noted that in some PSAP Test Areas the COS was reported in an alternate form (i.e., WRLS used in place of WPH1).

Project LOCATE provides in this Executive Summary Report a condensed view of the COS presented at the Target PSAP, as well as consistency and accuracy performance results, using the

FCC parameters by location solution as a guide. The data are presented for those WSPs that were common to at least two of the designated PSAP Test Areas.

WIRELESS SERVICE PROVIDER - 001

PSAP TEST AREA	Bexar County	Jasper County	Marion County	Onondaga County	Palo Alto	Rowan County
Location Tech Choice	Network	Network	Network	Network	Network	Network
Calls: WRLS COS	4.43%	9.36%	2.96%	5.42%	11.33%	0.00%
Calls: WPH1 COS	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Calls: WPH2 COS	89.66%	73.40%	39.41%	73.40%	45.81%	69.46%
Calls: Not WPH2	0.00%	0.00%	0.00%	0.00%	0.00%	4.93%
Locn Error OET-71 67% Index	55.00%	32.00%	24.00%	27.00%	52.00%	66.00%
Locn Error OET-71 95% Index	58.00%	39.00%	26.00%	27.00%	52.00%	72.00%
Calls: Dropped	0.00%	0.00%	1.97%	0.00%	0.49%	4.90%
Calls: Non Target PSAP	4.43%	13.30%	12.81%	11.82%	29.56%	18.23%
Calls: Poor Coverage	0.00%	0.00%	1.48%	6.90%	0.49%	0.49%
Calls: No Answer	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Calls: No Service	0.49%	3.45%	37.44%	0.99%	11.82%	5.42%
Calls: Other/Scheduled/ Channel Busy	0.99%	0.49%	3.94%	1.48%	0.49%	1.48%
Total Calls	203	203	203	203	203	203

WIRELESS SERVICE PROVIDER - 002

PSAP TEST AREA	Bexar County	Laramie	Marion County	Onondaga County	Palo Alto
Location Tech Choice	Handset	Handset	Handset	Handset	Handset
Calls: WRLS COS	1.97%	7.39%	3.45%	0.00%	8.87%
Calls: WPH1 COS	0.00%	0.00%	0.00%	11.33%	0.00%
Calls: WPH2 COS	91.63%	86.70%	52.22%	71.43%	38.92%
Calls: Not WPH2	0.00%	0.00%	0.00%	0.00%	0.00%
Locn Error OET-71 67% index	67.00%	67.00%	55.00%	67.00%	67.00%
Locn Error OET-71 95% index	90.00%	89.00%	57.00%	87.00%	80.00%
Calls: Dropped	0.00%	0.00%	1.97%	0.00%	0.00%
Calls: Non Target PSAP	3.94%	3.45%	13.79%	11.33%	39.41%
Calls: Poor Coverage	0.00%	0.49%	2.46%	3.45%	0.00%
Calls: No Answer	0.00%	0.00%	0.00%	0.00%	0.00%
Calls: No Service	1.48%	0.99%	23.65%	1.97%	10.84%
Calls: Other/Scheduled/Channel Busy	0.99%	0.99%	2.47%	0.49%	1.97%
Total calls	203	203	203	203	203

WIRELESS SERVICE PROVIDER - 003

PSAP TEST AREA	Bexar County	Laramie	Marion County	Onondaga County	Palo Alto
Location Tech Choice	Handset	Handset	Handset	Handset	Handset
Calls: WRLS COS	1.97%	7.39%	3.45%	0.00%	8.87%
Calls: WPH1 COS	0.00%	0.00%	0.00%	11.33%	0.00%
Calls: WPH2 COS	91.63%	86.70%	52.22%	71.43%	38.92%
Calls: Not WPH2	0.00%	0.00%	0.00%	0.00%	0.00%
Locn Error OET-71 67% index	67.00%	67.00%	55.00%	67.00%	67.00%
Locn Error OET-71 95% index	90.00%	89.00%	57.00%	87.00%	80.00%
Calls: Dropped	0.00%	0.00%	1.97%	0.00%	0.00%
Calls: Non Target PSAP	3.94%	3.45%	13.79%	11.33%	39.41%
Calls: Poor Coverage	0.00%	0.49%	2.46%	3.45%	0.00%
Calls: No Answer	0.00%	0.00%	0.00%	0.00%	0.00%
Calls: No Service	1.48%	0.99%	23.65%	1.97%	10.84%
Calls: Other/Scheduled/Channel Busy	0.99%	0.99%	2.47%	0.49%	1.97%
Total calls	203	203	203	203	203

WIRELESS SERVICE PROVIDER - 004

PSAP TEST AREA	Bexar County	Marion County	Onondaga County	Palo Alto	Rowan County
Location Tech Choice	Handset	Handset	Handset	Handset	Handset
Calls: WRLS COS	18.72%	16.26%	0.00%	34.48%	0.00%
Calls: WPH1 COS	0.00%	0.00%	0.00%	0.00%	0.00%
Calls: WPH2 COS	67.00%	29.06%	75.37%	27.09%	20.69%
Calls: Not WPH2	0.00%	0.00%	0.00%	0.00%	49.26%
Locn Error OET-71 67% index	67.00%	50.00%	1.00%	67.00%	67.00%
Locn Error OET-71 95% index	95.00%	50.00%	1.00%	71.00%	94.00%
Calls: Dropped	0.00%	1.97%	0.00%	0.00%	0.00%
Calls: Non Target PSAP	5.91%	6.40%	15.27%	26.11%	12.32%
Calls: Poor Coverage	1.48%	2.96%	7.39%	0.99%	0.00%
Calls: No Answer	0.00%	0.00%	0.00%	0.00%	0.00%
Calls: No Service	4.93%	40.39%	0.99%	10.84%	16.75%
Calls: Other/Scheduled/Channel Busy	1.97%	2.96%	0.99%	0.49%	0.99%
Total calls	203	203	203	203	203

WIRELESS SERVICE PROVIDER - 005

PSAP TEST AREA	Bexar County	Jasper County	Marion County	Onondaga County	Palo Alto
Location Tech Choice	Network	Network	Network	Network	Network
Calls: WRLS COS	2.46%	10.34%	2.96%	0.00%	12.32%
Calls: WPH1 COS	0.00%	0.00%	0.00%	0.00%	0.00%
Calls: WPH2 COS	93.60%	63.05%	42.86%	82.27%	48.77%
Calls: Not WPH2	0.00%	0.00%	0.00%	0.00%	0.00%
Locn Error OET-71 67% Index	67.00%	45.00%	42.00%	9.00%	67.00%
Locn Error OET-71 95% Index	90.00%	50.00%	42.00%	13.00%	84.00%
Calls: Dropped	0.00%	0.00%	2.46%	0.00%	0.00%
Calls: Non Target PSAP	2.96%	15.27%	9.36%	11.82%	25.62%
Calls: Poor Coverage	0.00%	0.00%	1.48%	3.94%	0.49%
Calls: No Answer	0.00%	0.00%	0.00%	0.00%	0.00%
Calls: No Service	0.49%	9.36%	36.45%	0.99%	12.32%
Calls: Other/Scheduled/ Channel Busy	0.49%	1.97%	4.44%	0.99%	0.49%
Total Calls	203	203	203	203	203

WIRELESS SERVICE PROVIDER - 006

PSAP TEST AREA	Rowan County, NC	Onondaga County, NY
Location Tech Choice	Network	Handset
Calls: WRLS COS	0.00%	1.48%
Calls: WPH1 COS	0.00%	7.88%
Calls: WPH2 COS	18.36%	76.35%
Calls: Not WPH2	33.50%	0.00%
Locn Error OET-71 67% Index	0.00%	67%
Locn Error OET-71 95% Index	0.00%	76%
Calls: Dropped	0.00%	0.00%
Calls: Non Target PSAP	14.78%	9.85%
Calls: Poor Coverage	0.00%	1.48%
Calls: No Answer	0.00%	0.00%
Calls: No Service	34.02%	.49%
Calls: Other/Scheduled/Channel Busy	1.48%	.99%

Total calls	203		203

WIRELESS SERVICE PROVIDER - 007

PSAP Test Area	Rowan County, NC	Laramie, WY	Marion County, FL
Location Tech Choice	Network	Handset	Handset
Calls: WRLS COS	0.00%	1.48%	5.42%
Calls: WPH1 COS	0.00%	7.88%	0.00%
Calls: WPH2 COS	18.36%	76.35%	48.77%
Calls: Not WPH2	33.50%	0.00%	
Locn Error OET-71 67% Index	0.00%	67%	51%
Locn Error OET-71 95% Index	0.00%	76%	54%
Calls: Dropped	0.00%	0.00%	.49%
Calls: Non Target PSAP	14.78%	9.85%	9.85%
Calls: Poor Coverage	0.00%	1.48%	.99%
Calls: No Answer	0.00%	0.00%	0.00%
Calls: No Service	34.02%	.49%	30.54%
Calls: Other/Scheduled/Channel Busy	1.48%	.99%	.49%
Total calls	203	203	203

Project LOCATE conducted meetings with the individual WSPs for which test data was recorded at two or more PSAP Test Areas to review the results from each PSAP Test Area. These meetings also afforded an opportunity to discuss deployment decisions and issues, as well as potential ways to improve the performance of each system tested. A wide range of issues were identified which potentially contributed to these results.

The WSPs shared with public safety a desire to make improvements in the performance of systems, which do not meet the expectation of delivering useful wireless location data to the PSAP. The results of these meetings are expanded in another section of this report. As a result of these post-test meetings, additional variables were identified that may have an impact on the quality of accuracy data delivered to the PSAP.

SUPPLEMENTAL TESTING PROTOCOLS AND SUMMARY OF RESULTS

Project LOCATE shared the initial testing results with the WSPs individually. In addition to the test data, WSPs were able to locate some data regarding the test calls from within their own systems. From those initial discussions, several important elements emerged that prompted the consideration and eventual commitment to conduct a series of supplemental test calls within one of the original PSAP Test Areas. In discussion with the WSPs, it was reported that subsequent rebids after presentation of the initial WPH2 COS would have provided improved location data information. Supplemental testing included recommendations made by the WSPs to augment the initial testing

protocols when an initial WPH2 was provided. Project LOCATE did not retest the other areas and the data presented in the previous section is from the original assessment effort.

Upon the request of the WSPs, Project LOCATE notified the WSPs of the supplemental test dates, test telephone numbers, specified the rebid timer and number of rebids to be used in the test. The supplemental test results (see chart on page 19) demonstrated that subsequent rebids could improve location information, but in some situations did not. The most significant change in test results for one WSP was the result of a network correction made by that WSP which was prompted by the initial Project LOCATE test results.

Project LOCATE and the WSPs learned the long-held premise that a call delivered to the PSAP with a COS of WPH2 was a valid representation that the latitude and longitude location coordinates of the wireless E911 caller's wireless telephone had been calculated may not be true in every case. Unique features of the deployed equipment within some areas provided only an initial location fix and, if rebids were properly used, a better wireless location data estimate might be produced at the PSAP. Also, certain deployed equipment in some areas held wireless location data from previous callers and that data might be displayed as a function of the timers on this data cache. The testing also showed, that alerting the WSPs prior to the date and times of testing, as well as the telephone number of the test wireless telephone, would allow the WSPs to better track the actual call process and associated wireless location data.

Project LOCATE found that these per-element variables of deployed systems were not always known to the WSP and certainly not to the PSAP; therefore, the expectation of service capability was inconsistent with the actual ability of particular deployed area subsets to deliver the anticipated best location on the initial WPH2 delivery.

A new set of 203 test calls was generated for the selected single PSAP Test Area chosen for the supplemental testing effort. The WSPs were given due notice of the testing dates and time, including the individual wireless telephone numbers for each test wireless telephone to be used. A full round of additional test calls were made, and the calltakers were instructed to rebid even if the first delivered COS was WPH2.

The adjusted testing protocol included:

To conduct the test and ensure the data captured is properly matched between the Data Collection Unit (DCU) and calltaker records, and that the field-testing software was modified to log multiple rebid results. A minimum of three WPH2 coordinates in sequence should be captured to establish a trend at any one test location, each resulting in an error distance relative to the test location's ground truth coordinates.

The software was modified to allow a minimum amount of time for a WSP to recalculate a fix and deliver it to the appropriate calltaker. The logic sequence will consist of the following series of steps:

1. Initial call results in either a WPH2 or no-WPH2 class of service.
2. Request a manual rebid.
3. Initiate the rebid timer. At the 22-second interval, verification that a WPH2 call is received is requested from the calltaker.
4. If the call results in either a WPH2 or non-WPH2 class of service, a manual rebid is requested.
5. Proceed to Step 3. Stop call when three WPH2 coordinates are received.

The test data for each WSP was provided to the WSP for prompt review and correlation with their own internal analysis. A separate meeting was scheduled with each WSP to discuss the results employing their recommended steps for demonstrating improved quality of wireless location data delivered to the PSAP.

The chart below shows the results of this supplemental testing effort by WSPs in the following order:

WSP	Location Technology	Data Delivered Better Than FCC Requirement	WPH2 Delivered with Initial Call	Percent of Time Location Improved with Rebid	Location Accuracy Score with 90% Confidence	Results Compared with Prior Test
001	TDOA	86% (<300m)	93%	23.65%	61% / 64%	Improved
002	GPS/AFLT	98% (<150m)	26%	53.86%	67% / 92%	Improved
003	GPS/AFLT	73% (<150m)	33%	40.41%	28% / 44%	Degraded
004	GPS/AGPS	99% (<150m)	3%	34.54%	67% / 95%	Improved
005	TDOA	87% (<300m)	13%	57.79%	55% / 71%	Improved
006	GPS/AFLT	94% (<150m)	20%	33.46%	67% / 86%	Improved

Project LOCATE and the WSPs found that during the supplemental testing, the DCU which was connected to one of the redundant ALI links and logging data as sent by the WSP had logged a number of duplicate entries. This anomaly did not occur with all WSPs, nor was the number of duplicate records consistent among those that did have such records within their data set. The impact of this still unexplained circumstance does not affect the location accuracy performance of the WSP; however, it does change the percentage of times the wireless location data improved with a rebid, which has been modified accordingly in the above table.

DEVELOPING A POSITIVE PARTNERSHIP TO IMPROVE SERVICES

APCO recognizes that in times of crisis, the wireless telephone caller is at that moment a customer of both the WSP and the PSAP that receives the call. In the critical moments of determining location, assessing severity and assigning call codes and priority, there is little to be gained from trying to educate the caller that their wireless telephone does not work exactly the same as their home wire line telephone does when accessing 911. During those seconds, the PSAP has the burden of meeting the expectation of the caller in crisis. This responsibility means sending the right resources to the right location, now.

Project LOCATE has a demonstrated history of working with and assisting PSAPs, Field Agencies, the FCC, NRIC and the WSPs individually and jointly at Emergency Services Interconnection Forum (ESIF) on meeting the expectations of the public relating to effective wireless Phase II deployment.

This history has produced meaningful benefits as well as lingering frustrations; however, APCO, on behalf of public safety, recognizes that working in partnership with the WSPs is the appropriate path and, in most cases, avoiding what could become a steady stream of complaints to the Wireless Enforcement Bureau of the FCC.

Project LOCATE approached this testing effort with the same hope that finally having useful location accuracy data from a diverse sample set, will result in a positive partnership toward improving service to all PSAPs.

The ongoing, candid discussions between WSPs and Project LOCATE in this arena has produced an initial document of Effective Practices, both for wireless Phase II deployment and for performance assessment of currently deployed systems.

PROJECT LOCATE EFFECTIVE PRACTICES

The Project LOCATE Team, consistent with the objectives of the PSFA Grant Award, identified the lessons learned and translated them into Effective Practices under nine separate topical areas. PSAP managers, as well as their executive-level decision makers, will benefit from reviewing these Effective Practices. Additional support and collaboration on the issues are available from Project LOCATE Team members and APCO staff. It is anticipated that while these Effective Practices may be revised upon annual review, additional demonstrated Effective Practices may be added to the appropriate categories as well.

The following abbreviations will be utilized throughout the effective practices:

- AHJ - Authority Having Jurisdiction
- PSAP - Public Safety Answering Point
- WSP - Wireless Service Provider, also known as Wireless Provider

The Effective Practice numbering scheme utilized
will be:

- 3807Xx
- 38 Recognizes Project LOCATE as the author of the Effective Practice
- 07 Year Effective Practice was established
- X (1-9) Topical Area (TA)

x Effective Practice within a section

The TA or Topical Area Identification Label

1. Policy Issues
2. Managing Public Expectations
3. Managing PSAP and Responder Expectations
4. Rebids / Re-Inquiry
5. Confidence and Uncertainty
6. Towers

7. Cache
8. PSAP Performance Testing
9. WSP – PSAP Area Testing

TA 1: POLICY ISSUES

380711 The AHJ should designate a wireless 911 deployment coordinator per PSAP service area.

380712 The AHJ should consider a comprehensive effort to fully inform PSAP service area decision makers of the nature and dynamics of Wireless 911 deployment practices of the WSPs and the impact upon delivery of consistent and usable dispatch information to the PSAP.

380713 The WSPs and the AHJ within each PSAP service area should develop and maintain a documentation process which defines the roles and responsibilities of each (i.e., a simple checklist). As appropriate, the timeline of all testing activity including end-to-end assessments and processes to resolve issues related to deployment and testing efforts should be included.

380714 Each WSP and the AHJ over the PSAP(s) within any service area should define and develop in writing the process to resolve issues related to deployment and all related testing efforts. (See Also Appendix C)

380715 The AHJ and the WSPs in order to sustain a professional partnership to achieve the optimum level of wireless E911 service should maintain open and candid communications. The effort should include developing and maintaining current contact information for the primary contact personnel within operations and management.

380716 The AHJ should consider consistent processing of required information to develop the Memorandum of Understandings (MOUs) between all WSPs in the jurisdiction of the AHJ. (See Also Appendix C)

380717 The AHJ should be aware of any cost recovery parameters, restrictions and requirements in their state.

TA 2: MANAGING PUBLIC EXPECTATIONS

380721 The AHJ should document and provide (such as on the AHJ website or via brochures) the assessment of wireless E911 service performance within the AHJ service area, which might include service description by topologies, but should avoid WSP-specific detail. Since deployed systems change over time, the assessment effort should be continually reviewed and updated to identify changes in system performance.

380722 The AHJ and the WSPs should work in a collaborative manner to develop and distribute informational materials to assist consumers in understanding there may be differences between wireless E911 expectations and the actual wireless 911 service performance within the PSAP service area.

380723 The AHJ and the WSPs should jointly identify any environments which may reduce the delivery of useful location data to the PSAP and include this data on the AHJ's and WSPs' websites.

380724 The WSPs should collaborate with APCO Project LOCATE to develop and regularly update information for public outreach (i.e., a message related to non-initialized wireless telephones or donation of pre-owned wireless telephones). Jointly developed information should be posted on the APCO's and WSPs' websites for access by public policy-makers and public safety professionals.

TA 3: MANAGING PSAP AND RESPONDER EXPECTATIONS

380731 The AHJ should agree to a wireless ALI format.

380732 The WSP in a jurisdiction should comply with the selected ALI format.

380733 The AHJ should educate calltakers and responders that there are many variables that affect routing, COS and location data presented to the PSAP.

380734 The AHJ should educate calltakers and responders of the current FCC accuracy compliance requirements[5] are not required to be measured and reported at the PSAP level by the WSP; however, current system performance in terms of usefulness and consistency of location data delivered to the PSAP is necessary for effective dispatch of emergency services and locating the wireless caller.

380735 The AHJ should establish baseline performance and conduct regular assessments and comparisons to the baseline.

380736 The AHJ should educate calltakers and responders to use all available resources to validate location data presented by the WSP.

380737 The AHJ should incorporate the results of its local testing program into its PSAP training program. The training program should provide the 911 calltakers with an enhanced understanding of the strengths and weaknesses of the Phase II wireless E911 systems throughout the PSAP service areas and the operational impact on responders.

380738 The AHJ should have a formal internal process in place for timely reporting, tracking and resolution of any wireless performance anomalies.

380739 The AHJ should be aware of ATIS 05000010 (Maintenance Testing) troubleshooting parameters and make them part of the AHJ formal internal process.

TA 4: REBIDS / RE-QUERY

380741 The AHJ should not rebid (automatically or manually) less than 30 seconds after the call is first presented to the calltaker. Any subsequent rebids should be at 30-second intervals. If automatic rebid is used, only the first rebid should be automatic.

380742 The AHJ should educate the calltakers that when rebids are implemented, a momentary intermittent disruption of the voice path may occur in some cases, (also known as "audio blanking"). The calltaker should advise the wireless caller and instruct them not to end the wireless telephone call and stay on the line.

[5] FCC 94-102, Third Report and Order

380743 The AHJ should rebid all wireless calls when the wireless caller is not able to provide a location, even if the call is initially presented to the calltaker as a WPH2.

380744 Each WSP should provide the AHJ with the current definition of quick fix/pre-fix or similar process if used to initially route a call.

380745 The AHJ should be aware that the exact same latitude and longitude presented after multiple rebids indicates improved location is not available. When rebidding, the calltaker would normally expect a change in latitude/longitude. The calltaker should check the COS, if it is WPH2 and it continues to be the same latitude/longitude, a note should be made of the information and then referred to the WSP. (Refer to Confidence and Uncertainty section.)

TA 5: CONFIDENCE AND UNCERTAINTY

Definitions

Confidence: Information identifying the confidence by which it is known that the calling party lies within the associated shape description; expressed as percentage.

Uncertainty: Information that indicates the level of uncertainty inherent to the associated longitude/latitude information; expressed in meters.

380751 The WSP should fix the confidence value in the location-determining algorithm at a value greater or equal to 90 percent and vary the uncertainty value. This value may change over time as more research and understanding of networks are conducted and analyzed. Reference Appendix A

380752 The AHJ and the PSAP(s) should jointly decide on the display/usage of the confidence value in order to specify to the WSP the suppression (or sending) the confidence value to the PSAP. It is recommended that the confidence value be suppressed and not displayed.

380753 The WSP should deliver an uncertainty value to the PSAP along with the location information on all WPH2 calls.

380754 APCO and the WSPs should seek to define uncertainty value thresholds/trends in order to provide PSAPs with guidelines for additional (two or more) rebids.

TA 6: TOWERS

380761 The WSP should secure and provide to the AHJ an MSAG valid address for all towers within and adjacent to the service area of the AHJ for wireless E911 systems. The AHJ should verify the tower address provided by the WSP is MSAG valid and reply to the WSP in a timely manner.

380762 The WSP should provide the AHJ with sector identification on the towers (such as east, west, north, south, southeast, etc). Omni-directional towers should be so identified.

380763 The appropriate AHJ(s) shall define and provide routing instructions to the WSP for all tower sites and default PSAP(s) within an agreed time frame. (Reference ESIF Issues 35 & 36 at www.atis.org)

380764 The WSP should provide correct information to the AHJ prior to any new tower being placed into service for testing. The AHJ should compile contact information and provide it to the appropriate operations staff. The AHJ must keep contact information lists current as information is provided by the WSP.

380765 The AHJ should establish a productive working relationship with WSP representatives responsible for implementation and maintenance. The WSP should provide the current appropriate representatives' contact information to the AHJ.

380766 The WSP and the AHJ should collaborate on a data and routing maintenance process and commit to continual review with associated follow-up. Reference ATIS 05000010 (Maintenance Testing) and ESIF Issues 35 and 36 at www.atis.org)

380767 The AHJ and the WSP should collaborate on a process for the reconciliation of identified misrouted wireless E911 calls and other system anomalies.

380768 The AHJ should request cell and routing data in the MPC or GMLC for their service area and perform annual reviews. Upon completion, results should be furnished to the WSP for their review.

TA 7: CACHE

380771 The AHJ should be aware that cache has an operational impact on the accuracy of the wireless location data delivered.

380772 The WSP should provide to the AHJ an engineering description of cache sufficient to allow the AHJ to determine the operational impact within the jurisdiction.

TA 8: PSAP PERFORMANCE TESTING

380781 The AHJ should (in an effort to better understand any potential disparity caused by multiple factors throughout its service area) implement a program to test the performance of the WPH2 systems to include routing, usable data presented at the PSAP, and location performance in the various topologies in the PSAP Service area.

380782 The AHJ should communicate with the WSP to inform the WSP of testing to be conducted, the methodology to be utilized and the specifics of the service deployed in the service area.

380783 The AHJ and the WSP should discuss specific testing methods and expectations for each location technology (i.e., testing in moving vehicles, indoor testing, rural versus urban etc.).

380784 Both the AHJ and the WSP should work together to interpret the testing results and agree on a plan to address identified deficiencies to ensure that the system is performing as optimally as possible in the service area. Correction plans should include retesting to allow assessment of improvements in system optimization.

380785 The AHJ should incorporate the results of its local testing program into its PSAP training program.

TA 9: WSP – PSAP AREA TESTING

380791 If call through performance testing to the PSAP will be conducted, the WSP should provide a mutually agreed upon notification to the AHJ prior to any testing in its jurisdiction.

380792 Compliance accuracy testing methodology used by the AHJ or the WSP should fall within the guidelines set forth in OET 71 or ATIS 050-0001.

380793 During the call through performance testing to the PSAP testing process, the AHJ should monitor the process to ensure there is consistency between the pANI[6] sent by the WSP and the information displayed at the PSAP.

380794 Call through performance testing to the PSAP testing should be designed in such a way to validate routing and delivery of format and content of ALI display at the PSAP as defined by the AHJ.

380795 The WSP and the AHJ should mutually agree to an end-to-end field-testing schedule to minimize the impact of and disruption to the PSAP operations.

380796 The WSP and the PSAP should ensure that all individuals involved in the testing process have appropriate contact information prior to the beginning of the testing process (i.e., WSP Team Leader and the PSAP 24x7 supervisor number).

380797 The WSP and the AHJ should mutually agree to a field-testing process that tests tower locations, sectors, and commonly available handset categories in the PSAP service area.

380798 The WSP and the AHJ should independently document and record the results of testing. Subsequent to the completion of the testing, the WSP and the AHJ should meet to review and discuss testing results and agree to the methodology for any possible retests.

380799 The WSP and the AHJ should mutually agree upon notification to the PSAP prior to any network changes which may have impact on PSAP operations.

FINDINGS AND RECOMMENDATIONS

There has been and continues to be a clear public expectation that the PSAP, as well as traditional first responders, will actually have consistent and accurate wireless location data delivered with all wireless 911 calls to the PSAP. This expectation exceeds the performance of many systems as deployed and evaluated as part of a designated PSAP Test Area. Public education with the goal of better managing the expectation of current service must be developed and distributed widely. Managing the expectations of first responders, as well as PSAP staff, must also be expanded and call management processes that have general applicability rather than provider specific interpretations must also be adopted.

[6] pseudo automatic number identification

The AHJ should implement baseline performance testing to better evaluate and understand how the system(s) serving the PSAP(s) collects and processes location data that is delivered to the PSAP.

The Effective Practices contained herein, many of which have gained consensus by public safety through Project LOCATE and the WSPs, should be reviewed, understood and practiced in order to maximize system service potential.

The public safety community would be best served by developing a positive partnership with the WSPs within their service area, demonstrating a solid understanding of the technology and options available, as well as maintaining open and candid communications regarding performance and service. The importance to the individual caller in crisis reaches beyond differences of opinion regarding responsibility and obligations.

The supportive information contained within the attached Appendices should be reviewed and used properly to better understand wireless E911 services as well as better manage the expectations of the public and public safety/service stakeholders.

While the need for continued evolution and investment in location technology to support public safety is recognized and acknowledged, interim improvements in today's deployed systems also have benefits and are encouraged.

In conclusion, we understand that there are limitations to today's position determining equipment. We understand that there are business reasons for the networks deployed as they are today. We understand that the FCC accuracy parameters do not currently apply at the PSAP level. We understand that there are costs associated with any modification to existing infrastructure. We understand that performance testing of current systems at the local level has cost and time implications for local government and average consumer.

However, the challenge to provide useful location information to the PSAP for effective response to nearly half of the estimated 200 million 911 calls made annually cannot be ignored.

On behalf of every caller in crisis, it is incumbent upon all public safety and wireless community stakeholders, supported by appropriate regulatory and legislative action, to continue the collaborative effort to maximize the usefulness and consistency of wireless location data provided to the PSAP.

APPENDIX A

Project LOCATE provides readers with several documents approved or in development at the time of publication which may assist in better understanding the dynamics of wireless 9-1-1 services. These documents are the product of the Alliance for Telecommunications Industry Solutions (ATIS), which formed the ESIF, which serves as the primary venue for the telecommunications industry, public safety and other stakeholders to generate and refine both technical and operational interconnection issues. This includes those that impact the future of what public safety knows to be the life-saving E9-1-1 services that are generally available for everyone in almost all situations. ESIF allows many different telecommunications entities to fully cooperate, connect and collaborate with each other to reach a practice and/or solution that can be adopted by the majority and is related to the effective and prompt deployment of E9-1-1 services nationwide.

ESIF's mission is to facilitate the identification and resolution of both technical and operational issues related to the interconnection of telephony and emergency services networks.

APCO has participated as a member of ESIF for over five years, seeking to clarify and represent the interests of public safety in general and PSAPs in particular. There are relatively few public safety voting members and the development of work products, such as these documents, is always difficult and time consuming. The private industry representatives from the WSP and their contractors are exceptionally skilled individuals that usually become the editor of such documents.

APCO Project LOCATE provides this Appendix of selected ESIF documents for use as necessary.

Documents and Topics:

Confidence and Uncertainty
Mid Call Location Update (Re-Bid)
High Level Accuracy Testing
Maintenance Testing
Wireless 9-1-1 Testing Definitions

APPENDIX A: 001

Confidence and Uncertainty

July 17, 2003

ESIF Recommendation for Use of Confidence and Uncertainty for Wireless Phase 2

This is the Emergency Services Interconnection Forum (ESIF) recommendation for managing location confidence and uncertainty for Wireless Phase 2 calls. The Position Information for Emergency Services is defined in ANSI T1.628-2000, Emergency Calling Service. It defines confidence and uncertainty as follows.

"uncertainty code: Information that indicates the level of uncertainty inherent to the associated longitude/latitude information." "The uncertainty *r*, expressed in meters (in the range 1m to 1800km)…"

"confidence: Information identifying the confidence by which it is known that the calling party lies within the associated shape description. The confidence by which the location is known to be within the shape description, C (expressed as a percentage) is directly mapped from the binary number K, except for K=0 which is used to indicate 'no information', and $100 < K \leq 127$ which are not used."

ESIF has not made a recommendation on whether confidence and uncertainty should be delivered to the PSAP, but does have a recommendation upon the use and interpretation of confidence and uncertainty if they are delivered to the PSAP.

If confidence and certainty can be determined by the location technology then the location technology should fix confidence and vary uncertainty to illustrate the probable location of the caller.

The PSAP community is cautioned in the use of uncertainty. Because uncertainty is expressed as a circle radius and the actual algorithms to produce the location do not produce circles (e.g. some produce ellipses), there are some inherent errors in the calculation of uncertainty. Therefore, the delivery of confidence and uncertainty to the PSAP can only be used for the dispatch of responding agencies to the scene and not to verify compliance of the Position Information with the FCC mandate for accuracy

APPENDIX A: 002

Confidence and Uncertainty – Nextel Position

- Nextel cannot support the NENA recommendation to have carriers set confidence at 90% if they are going to send an uncertainty to a PSAP.
- Uncertainty validation can only be performed via a direct comparison with a known accurate ground truth point.
- Nextel's current implementation allows our system to meet the FCC requirement that R < 50 meters (67%), as tested by an independent contractor.
- Nextel meets FCC requirements regardless of the uncertainty that is sent to the PSAP.
- In Nextel's implementation the Uncertainty is represented by the EPE (Estimated Position Error), which is at a confidence set at 39.4% in a Gaussian model.
- A 2D Confidence value of 39.4 % represents a 1-sigma probability, which is a popular value used by most makers of GPS handheld units (e.g. Garmin, Magellan, Trimble).
- If a 39.4% Confidence with a 100-meter Uncertainty is changed it to a 90% Confidence, the Uncertainty would become 215-meters.
- If Confidence is increased, then the Uncertainty will also increase in a Gaussian function.
- Nextel believes that increasing Confidence level at the expense of increasing Uncertainty is not worthwhile.
- Increasing Confidence level without degrading Uncertainty is not technically feasible in our AGPS implementation.
- Nextel would like to see and understand the statistical models that were used for the recommendation to increase the Confidence to 90%.
- Carriers that have made the recommendation to increase the confidence to 90 percent need to specify what (and if) Uncertainty will be provided to the PSAP.
- Contributions into the WG by carrier's representing the different technologies should be made available for Nextel's review.

APPENDIX A: 003

Confidence and Uncertainty
July 21, 2005

Emergency Services Interconnection Forum (ESIF)
Recommendation for the Use of Confidence and Uncertainty
for Wireless Phase 2

This is the Emergency Services Interconnection Forum (ESIF) recommendation for managing location confidence and uncertainty for Wireless Phase 2 calls. The Position Information for Emergency Services is defined in ANSI T1.628-2000, Emergency Calling Service. It defines confidence and uncertainty as follows.

> "uncertainty code: Information that indicates the level of uncertainty inherent to the associated longitude/latitude information." "The uncertainty *r*, expressed in meters (in the range 1m to 1800km)…"

> "confidence: Information identifying the confidence by which it is known that the calling party lies within the associated shape description. The confidence by which the location is known to be within the shape description, C (expressed as a percentage) is directly mapped from the binary number K, except for K=0 which is used to indicate 'no information', and 100 < K ≤127 which are not used."

ESIF has a recommendation upon the use and interpretation of confidence and uncertainty. If confidence and uncertainty can be determined by the location technology, then the location technology should fix confidence and vary uncertainty to illustrate the probable location of the caller. Issues are identified by number.

As to delivery of confidence and uncertainty to the PSAP along with location information (i.e., latitude and longitude), ESIF recommends that uncertainty be delivered to the PSAP. Confidence can be optionally delivered across the E2 interface. If the option is to not send confidence, then the E2 confidence field will be populated with zero. As confidence will never be computed at zero percent, a value of zero implies "no information" (in accordance with T1.628). As to confidence being displayed at the PSAP, ESIF recommends that confidence not be displayed at the PSAP, regardless of whether the confidence comes across the E2 interface.

Background
ESIF Subcommittee C explored the implementation of location determination with vendors developing this technology. All of the vendors use proprietary algorithms to determine the location of a wireless caller. In most cases the longer the sampling period the more accurate the location presented. All of the vendors surveyed fix confidence and let uncertainty vary as they refine the location fix. Each vendor sets the confidence at a different percentage value. The period of time to determine a satisfactory location is determined by making a statistically significant number of location fixes to meet the FCC requirements for location accuracy. Therefore, there is value to the PSAP in delivering uncertainty, but since the confidence value is fixed, it provides no additional information that would be of value to the PSAP in dispatching emergency resources.

The PSAP community is *cautioned* in the use of uncertainty. Because uncertainty is expressed as a circle radius and the actual algorithms to produce the location do not produce circles (e.g., some produce ellipses), there are some inherent errors in the calculation of uncertainty. Therefore, the delivery uncertainty to the PSAP can only be used for the dispatch of responding agencies to the scene and not to verify compliance of the position information with the FCC mandate for accuracy.

APPENDIX A: 004

Mid-Call Location Update aka Re-Bid
April 3, 2003

SG C Recommendation to ESIF General Session Regarding Issue 19

Re: Mid-Call Location Update, ESIF Issue 19

Mid-Call Location Update (MCLU) is the capability for a PSAP to query (rebid) for updated WPH2 Position Information of a mobile caller. Although MCLU is not required by the FCC Phase II mandate (but is implied in OET-071), there are a couple of legitimate reasons why the PSAP may have to re-query for Position Information. First, the caller's location may not have been determined by the location technology by the time the emergency call was delivered to the PSAP and the PSAP makes its initial bid for location. In this case the PSAP will receive Phase I information and may be prompted to rebid for Phase II information. If the time between the initial bid and rebid is sufficient, the location technology should have been able to locate the caller's position and it can be returned to the PSAP. Second, the PSAP call taker may determine that the caller is moving and because of the situation may have a need to obtain the current location. In this case the network will re-locate the caller and return their position to the PSAP. If a new location cannot be obtained by the network, the "last known" position may be returned.

While further experience is needed to determine the optimum interval for the re-bid, the ESIF recommendation is to wait 30 seconds after the initial bid if it is determined that a position update is required. There are a two of reasons for this. First, an additional 30 seconds should be sufficient time for the location technology to determine a Phase II compliant location fix. Second, some network elements will actually throttle PSAP requests and if they occur too frequently will return the last known address rather than requesting a new location fix.

There have been some requests that CPE vendors develop into their systems repetitive automatic re-bids. That is, without call taker intervention, the CPE would repetitively request an updated location. ESIF strongly recommends against this implementation. Not all calls require an accurate location of the caller. For example, callers reporting the same traffic accident need to be handled quickly so that the call taker can be ready for the next call. Not only is an initial location not needed, but clearly a rebid is not required. If every wireless call resulted in a rebid, the number of ALI bids would be twice that of a wireline call. And, if for an example, wireless calls rebid every thirty seconds for two minutes, the number of ALI bids would quadruple over wireline calls. This data traffic represents a real concern relating to the sizing of network elements and data networks that would have to be upgraded to accept this increased load.

Finally, early on in the discussions regarding WPH2, there were concerns expressed that location updates of a caller may lead to privacy concerns. It is ESIF's position that when a caller makes a 9-1-1 call they give up their right to privacy and the location of the caller may be delivered to the PSAP without any regards for screening.

Contribution G-37 (6/16/06)
Doug Stuard, Technical Editor

APPENDIX A: 005

Maintenance Testing – ESIF Issue 33 - Revision 11
Reproduced here at the request of the WSP
Current as of January 01, 2007

ESIF TECHNICAL REPORT

ATIS-0500010

ATIS is a technical planning and standards development organization that is committed to rapidly developing and promoting technical and operations standards for the communications and related information technologies industry worldwide using a pragmatic, flexible and open approach. Over 1,100 participants from more than 350 communications companies are active in ATIS' 22 industry committees, and its Incubator Solutions Program. www.atis.org

REVISION HISTORY

ATIS-0500001
Maintenance Testing

Version	Date	Changes
1.0	xx-xx-2006	Initial Release

ATIS-0500010: *Maintenance Testing* is an ATIS standard developed by the following committee(s) under the ATIS User Interface functional group:

The Emergency Services Interconnection Forum (ESIF), Subcommittee G

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INTRODUCTION

The United States Federal Communications Commission has established accuracy requirements for network and handset based location solutions for Enhanced 9-1-1 emergency call services. These requirements can be found in the Commission's Third Report and Order, adopted September 15, 1999.

The Emergency Services Interconnection Forum (ESIF) identified the need for industry accepted methodologies for testing the accuracy performance and end-to-end functionality of Wireless E9-1-1 Phase 2 systems, both for initial assessment testing as well as ongoing maintenance testing. Requirements for accuracy testing methodologies were addressed in ATIS Standard ATIS-0500001, released in May of 2004, and end-to-end testing requirements were addressed in ATIS Standard ATIS-0500009, released in June 2006. This document is divided into two sections; Part 1 addresses maintenance testing for accuracy, and Part 2 addresses maintenance of end-to-end functionality testing for Phase 1 and/or Phase 2 Wireless E9-1-1 systems.

This document neither recommends nor imposes a specific test methodology, but rather provides a common frame of reference that individual stakeholders can use to ensure continued accuracy and functionality compliance of Phase 1 or Phase 2 E9-1-1 integrated networks through the inevitable updates and changes that occur over time, and provides a set of minimum requirements for individual test methodologies.

Every possible effort has been made to ensure that these requirements remain technology neutral.

Per current ESIF Operating Guidelines, due process has been followed in the creation of this document, and development has been open for participation within the bounds of ESIF.

Scope

This document defines the requirements and testing procedures needed to perform maintenance testing for accuracy, as well as the requirements and testing procedures needed for maintenance testing of end-to-end functionality in wireless E9-1-1 Phase 1 or Phase 2 systems.

Acknowledgements

Subcommittee G would like to thank its members for their active participation and contribution to the creation of this document.

References

[1] Enhanced Wireless 911 Phase 2
J-STD-036-B
Telecommunications Industry Association and Alliance for Telecommunications Industry Solutions
June 2006

[2] High Level Requirements for Accuracy Testing Methodologies
ATIS Standard ATIS-0500001
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[3] High Level Requirements for End-to-End Functional Testing
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June 2006

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[7] Revision of the Commission's Rules to Ensure Compatibility with 911 Emergency Calling Systems, CC Docket No. 94-102, *Memorandum Opinion and Order*, FCC 03-262
Federal Communications Commission, USA
Nov. 3, 2003

[8] Near Term Issues for Emergency / E9-1-1 Services, Final Report
Network Reliability and Interoperability Council VII (NRIC VII), Focus Group 1A
December 2005

[9] Emergency Services Interconnection Forum (ESIF)
Issue 38 - Uniform Approach for Deriving Class of Service Oct. 20, 2006

Definitions

This section offers a few definitions found to be important to maintain a common vocabulary throughout the creation of this document

Accuracy Testing

Accuracy testing, whether through empirical and/or predictive test methods, consists of generating location data to gauge the accuracy performance of the system. Location data, typically significant in volume, involves the location infrastructure of the carrier's network. The primary objective is to verify location accuracy and correct any location system errors. Limiting the test to the carrier's location network minimizes impact to the rest of the Phase II network and maximizes the capability of the carriers to optimize their system.

Event-Driven Accuracy Maintenance Trigger:

Any accuracy maintenance trigger arising from an incident within a test area or sub-area that might significantly alter the validity of pre-recorded empirical test data for the affected area.

Functionality Testing (End to End)

Functionality testing consists of testing the delivery of the location data from the carrier to the PSAP. The objective of this testing activity is to ensure interoperability between the carrier and the Emergency Service Network. This testing activity requires tight coordination among the involved parties, which normally includes the Emergency Service Network, the carrier and the technology vendors.

Initial Deployment (Phase 1 and Phase 2)

Deployment of Phase 1 or Phase 2 wireless location capability by a Wireless Service Provider (WSP) that has not previously deployed in a PSAP jurisdiction within the 911- Entity's region.

International Roamer

A subscriber handset that has local service outside of the United States.

Jurisdictional PSAP

The PSAP having primary jurisdictional responsibility for a given location.

KPI

Key Performance Indicator. KPIs consist of relevant location network metrics and ratios which can be helpful in detecting performance problems. Specific KPIs are typically technology and implementation dependent. In the context of functionality end-to-end maintenance testing, examples of KPIs might include monitoring Phase II yield, monitoring the mix of Phase II location types or the count of location requests by PSAP.

Maintenance Testing

Maintenance testing may be conducted after a system has been turned up with the Emergency Service Network. Like all network systems, maintenance testing will be conducted as needed to ensure functionality and performance. This testing activity may include functionality and/or accuracy testing and the participation of the Emergency Service Network may or may not be required. Maintenance testing can be a condensed version of the original accuracy and functionality testing.

pANI

The pseudo automatic number assigned to identify and an emergency call. Includes both ESRD and ESRK.

Phase 1 Response

A response shall be classified as Phase 1 when the location delivered is based on the cell sector from which the call originated. The displayed Class of Service may be either WRLS (no Phase 2 location capability exists), or WPH1 (Phase 2 capability exists but the specific caller location could not be determined). Cell sites with a sufficiently limited coverage radius may also be considered Phase 2.

Note: Class of Service displays may vary among 9-1-1 system service providers and are not controlled directly by the wireless carrier.

Phase 2 Response

A response shall be classified as Phase 2, with a WPH2 Class of Service, when the MPC/GMLC provides the estimated location of the caller. The Position Source value delivered to the ESME indicates a positioning method capable of determining the caller's location was used, regardless of accuracy. Cell sites with a sufficiently limited coverage radius may also be considered Phase 2.

Predictive Testing

A predictive test method consists of utilizing a predictive model to compute the expected accuracy of a location determining technology within a wireless carrier's service area. The predictive model takes into account the physical elements of the location determining system for network or handset based solutions as well as the relevant terrain and RF propagation characteristics.

PSAP Authority

The entity having responsibility for PSAP operations and function. This may be a local, regional or state level organization.

Roamer

A subscriber handset that has local service outside the WSP's local serving area, but within the United States.

Routing PSAP

Wireless network coverage areas and position determining systems do not typically align exactly with PSAP jurisdictional areas. The Routing PSAP is the PSAP to which a call from a given location is routed based on wireless system coverage factors and position determination capabilities, and may or may not be the same as the jurisdictional PSAP.

Timing and Latency

Timing refers to measuring the relative time of occurrence of events in the system relative to a common time reference. Latency refers to the elapsed time between the start of an event (or a specific sequence of events) in one part of the system and its (or their) conclusion in the same or another part of the system.

Uninitialized Handset

A handset that is not subscribed to any wireless service.

Acronyms

AFLT	Advanced Forward Link Trilateration
AGPS	Assisted GPS
ALI	Automatic Location Identification
ANSI	American National Standards Institute
AOA	Angle of Arrival
E-911	Enhanced 911 Emergency Service
ESRD	Emergency Services Routing Digits
ESRK	Emergency Services Routing Key
ESME	Emergency Services Messaging Entity
ESNE	Emergency Services Network Entity
GMLC	Gateway Mobile Location Center
GPS	Global Positioning System
GSM	Global System for Mobile Communications
MPC	Mobile Positioning Center
MSC	Mobile Switching Center
pANI	Pseudo Automatic Number Identification
PDE	Position Determining Equipment
PSAP	Public Safety Answering Point
RF	Radio Frequency
S/R	Selective Router
SMLC	Serving Mobile Location Center
TDOA	Time Difference of Arrival
U-TDOA	Uplink TDOA
WAAS GPS	Wide Area Augmentation System GPS

Part 1 Maintenance Testing for Accuracy

GENERAL Test Requirements

Introduction

Once a location system has been tested and found to be compliant[1,2] the wireless carrier shall ensure that its network maintains compliance through the accuracy maintenance test requirements established in this document.

OET-71 encouraged the development of accuracy test methods that were 'efficient, reliable, simple, and cost-effective'. These attributes are especially significant given the on-going nature of maintenance testing. It has been recognized by both ESIF and NRIC that 'maintenance testing can be a condensed version of the original accuracy and functionality testing'.

ESIF's goal in developing these requirements is to define efficient, simple and cost-effective maintenance test methods, which are still reliable and technically sound.

With this in mind, it is further recognized that maintenance testing efforts will typically not be full-fledged OET-71/ATIS-0500001 type tests, but may be scaled down in scope and/or spread-out in time (i.e, incremental testing).

1,2 FCC Office of Engineering and Technology Bulletin No. 71, "Guidelines for Testing and Verifying the Accuracy of Wireless E911 Location Systems", 12 April 2000. ESIF recommends that accuracy testing for compliance purposes be conducted in accordance with "High Level Requirements for Accuracy Testing Methodologies", ESIF Technical Report, ATIS-0500001, 23 July 2004.

Useful Life of Data

As maintenance testing within a given test area may occur over a period of time, the testing entity may accumulate a significant volume of test data. The maximum useable life of accuracy test data is established as two years if no other maintenance test triggers apply. Maintenance test triggers may necessitate a shorter data life span, otherwise the accuracy test data collected up to two years prior may be utilized in the analysis and/or reporting process for accuracy verification.

System Under Test

The following figures show the network diagrams for "system under test" for purposes of location accuracy maintenance testing. These diagrams identify various interface points where data collection may take place.

Collection of test call voice or data shall not impact the processing of live wireless E9-1-1 traffic, or become burdensome for PSAP operators.

The actual position of interface points in the wireless network is optional, but shall provide the same location data that would be delivered to the Emergency Services Network. The interface points shall provide E9-1-1 location data whether they are Phase 1 or Phase 2 based.

The figures represent typical Network Element configurations for ANSI and GSM wireless networks.

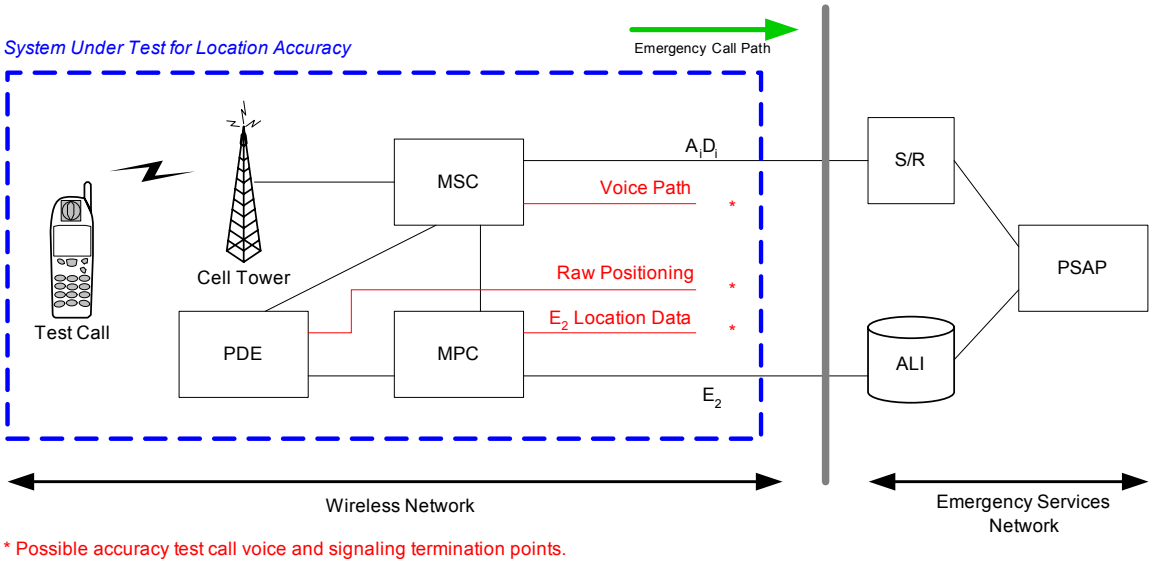


Figure 1: System Under Test, ANSI Network

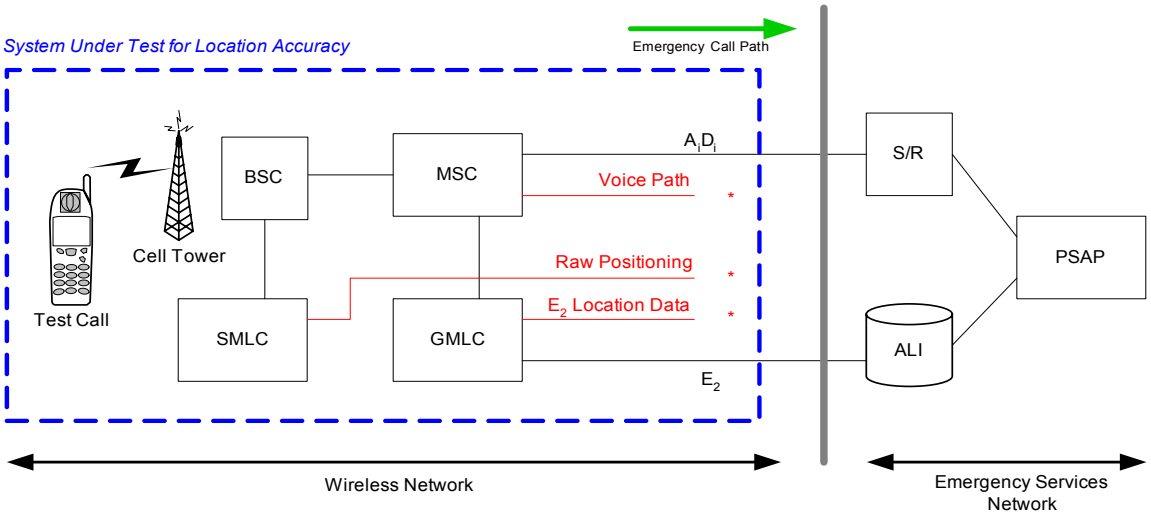


Figure 2: System Under Test, GSM Networks

Accuracy Maintenance Test Trigger Mechanisms

Maintenance testing shall be triggered by any of the following:

1. Major network changes that may significantly impact location accuracy;
2. Problems such as unexplained significant degradation of service; systematic failed delivery of service; catastrophic events (but not single failure events);
3. Every two years, as a minimum consistent with NRIC VII Focus Group 1A recommendations.

Accuracy Maintenance Test Trigger Examples

Examples of 'major network changes that may significantly impact location accuracy' and thus trigger maintenance accuracy testing on some or all of the deployed network might include:

- Change of core location technology;
- Major system software upgrades that impact location algorithms, which should be verified in representative deployments or configurations, where applicable;
- A change in RF configuration that would result in a significant impact to location accuracy in the area being considered, such as switch-wide CDMA PN (pseudo noise) code change or a significant change in the number of cell sites;
- A natural disaster that alters the topology of a significant portion of the infrastructure in an area of consideration;

Equipment Requirements

This section describes the equipment and tools typically used to conduct maintenance accuracy testing. Depending on specific methodology needs, some of the equipment listed in this section may be optional.

Test Phones

Test phone equipment must be available and representative of the Radio Access and Location Technologies in use by the Wireless Carrier. The capability to initiate test calls autonomously is acceptable.

Equipment to Establish Ground Truth

GPS Receiver

A Differential GPS (D-GPS) or Wide Area Augmentation System GPS (WAAS GPS) Receiver may be used as a tool for establishment of Ground Truth.

GPS Survey Equipment

Equipment used to generate Ground Truth to survey accuracy precision as desired. This may be needed in certain maintenance test scenarios depending on methodology adopted.

Inertial Navigation Systems

An Inertial Navigation System may be needed in situations where GPS reliability needs to be augmented, such as dense urban locations or indoors.

Notice that many high-end commercial surveying and navigation tools integrate GPS (Differential or WAAS) with Inertial Navigation devices, such as Gyroscopes and Accelerometers.

Portable Computer or Comparable Recording Device

May be used on the field to record and/or transmit test call data, such as ground truth, and assist with test execution.

Wireless Modem or RF Relay

A communications device may be used to transmit, receive and process field data to aid in the measurement of Ground Truth.

Data Recording Device

A Data Recording Device is a computer or comparable recording equipment. Such device may be used centrally or on the field to record test call data to provide automation and efficiency in the recording of data. Provisions for incremental data gathering and incremental reporting on an ongoing basis may be included.

Software Requirements

Test Point Ground Truth GPS Reference Database

A database of GPS reference points may be used in stationary call cases. Typically this may take the form of a software based collection of known geographic reference points, within the test area, including Latitude – Longitude (and possibly altitude) readings and descriptions.

Alternately, in methods that use fairly random calls placed along routes, these reference database entries would be substituted by the set of ground truths from which the maintenance test calls were placed. Note: care must be taken, e.g., through appropriate software averaging and filtering, to ensure that ground truth fidelity is maintained to within 10 m (per ATIS-0500001); this is particularly true if non-stationary calls are placed from moving vehicles.

Mapping Software

Mapping software running on a mobile test station laptop may be used as an interface to the D-GPS receiver. It makes it possible to identify, set-up, and navigate stationary test points, and drive test routes.

Data Recording Software

Software may be used to record, log, transfer, and receive test data, call information, routing information, timing data and other relevant information required.

Data Processing Software

Software may be used to automatically process the location accuracy when compared to ground truth and provide analysis and reporting to provide accurate and efficiently processed results. This software shall be capable of processing and comparing data gathered from ground truth equipment and the system under test and performing normalization of data necessary to account for varying time bases, geographic coordinate systems, scale factors, etc. The ability to process data gathered on an incremental basis may be included. If a methodology uses random sampling to obtain subsets from larger samples accumulated over time then the data processing software shall be capable of performing such sampling according to accepted statistical methods.

Test Area

Definition

Test area for accuracy maintenance is a geographical area designated by the wireless carrier and will be dependent on the type and/or reason maintenance testing is to be performed.

For example, the test area for major network changes that significantly impact location accuracy will be the geographical area that is impacted by the network change. Sample testing within this geographical area will be conducted to assess impact of network change on accuracy and to confirm that any negative accuracy impacts have been resolved or mitigated.

The test area for problems, as defined in the Accuracy Maintenance Test Trigger Mechanisms section of this document will be dependent on the type and scope of the problem and the problems potential for negatively impacting location accuracy.

The test area to meet the minimum maintenance test trigger of every two years will be dependent on what test data has aged beyond two years.

Empirical Test Methods

General

This section presents methods and recommendations regarding empirical testing that aim to attain the goals of efficient, reliable and cost effective yet technically sound maintenance testing. These methods & recommendations include:

- The incremental collection of empirical accuracy test data;
- A possible method to determine smaller test call sample sizes for a given test area after establishing an initial baseline per ATIS-0500001 is described with its statistical foundation and validity checks;
- Guidelines on the geographic distribution of the test calls for the purposes of maintenance testing; and
- Options that can simplify indoor testing.

Incremental Testing

Empirical accuracy test data can be incrementally collected over time, gradually building a set of accuracy test measurements generated from discrete test calls, which include a ground-truth reference. This is typically referred to as 'incremental testing'. It is recognized that this approach does not rely on any randomly uniform test point distribution for data collection;[3] however, a random sample may be chosen from collected data for analysis purposes. In this event, the method used for random selection of test calls should be documented.

Sample Size and Distribution

Introduction

Initial empirical compliance testing is done without prior knowledge of whether or not the test area conforms to the mandated accuracy requirement. This may require a sizable sample to establish accuracy performance with the desired level of statistical confidence (as established in OET-71). Subsequent testing, including maintenance testing, may be able to benefit from the knowledge that the system did previously comply, so long as the network and its environment have remained substantially the same since the initial testing. The result of this observation is that a smaller sample may be possible to use to achieve the same level of statistical confidence (nominally 90%). This is indeed the case if the location system continues to perform within specified operating parameters and the environment within which it operates (both physical and electromagnetic) has not changed in any material way that may adversely affect location system performance.

It is recommended that independent means be utilized to establish that no material changes have occurred that can impact location performance. Such means or systems should provide indicators that equipment that affects location performance is operating within known tolerances and environmental factors (interference, multipath, etc.) affecting location are within established limits.

Statistical Framework

For a network in which the location system conditions have not changed materially, confidence interval for means is a technique that can be applied to predict the adequacy of the size of a certain sample. It is particularly attractive, as it does

not involve making significant assumptions about the underlying distribution, which in this case is the distribution of the location error. The mean and the variance (standard deviation) are used as surrogates for the distribution in that if they have not changed from prior testing then the distribution is largely unchanged and so are its percentiles, most notably the 67th and 95th percentiles.

The fundamental assumption is that the variance (standard deviation) is known. The implicit assumption is that the conditions of the location system (including equipment performance), underlying wireless network (to the extent that it is involved in or affects location determination) and its area under test (i.e., the physical and electromagnetic environment) have not changed from previous testing so that the previous variance remains essentially unchanged. Appendix A has the conditions for the validity of this statistical framework and the equations that derive the size of the sample n.

The result

$n \geq 67.7\ [\sigma/\mu]^2$

where μ and σ are the mean and standard deviation, respectively, observed from previous testing, verifies, with 90% confidence, that the newly observed mean μ' is within +/- 20% of the value μ observed earlier. Further examples are provided in Table 1 for illustration. The table reflects the intuitive fact that the larger the variance or the tighter the desired maximum variation relative to the prior mean, the larger is the sample required (for a given confidence).

Further explanation is provided in Appendix A.

Table 1. Example of Sample Sizes

		Minimum Sample Size n for Different 90% Confidence Intervals	
		+/- 15% of μ	+/-20% of μ
Established Mean μ (meters)	Established Standard Deviation □ (meters)		
30	20	**54**	**31**
40	80	**482**	**271**
90	125	**232**	**131**

Post Testing Validity Checks

Certain validity tests should be performed after the reduced size sample is collected. The new mean μ' and new standard deviation σ' should be computed and if μ' is outside the confidence interval or σ' is quite different, e.g., by more than 20%, from the original standard deviation σ, or if the 67th and 95th percentiles are quite different from previously determined (e.g., not within the FCC specified thresholds) then the smaller sample is not adequate. Basically, the statistical test has failed and μ' is outside the confidence interval, or the basic assumption that the standard deviation is known is invalid, so a larger sample would be required. In general, the closer the system originally was to the thresholds of compliance the larger the required sample to ensure that the new 67th and 95th percentiles are within the mandated limits.

3 Incremental data collection would typically tend to follow the pattern of wireless network maintenance activities in the test area. This approach gives the carrier the option to empirically collect accuracy test data over time, perhaps through the use of existing test teams in the field in conjunction with other on-going maintenance test/network reliability efforts, resulting in reduced cost and simplified logistics for the data collection effort.

Baseline Data Currency

Since this method relies on the statistics of previously collected data, the new sample, collected incrementally or otherwise, should be gathered prior to the previous data becoming outdated.

Sample Geographic Distribution

It should be noted that the test calls for the new sample must be well distributed to span the area under test. In general the test calls should be sufficiently distributed to exercise a substantial portion of the system/coverage area under test or a majority of the location network elements (e.g., cell sites, location sensors, etc.) within the test area. For instance, test calls in San Francisco (or within a small fraction of the sectors within SF) would not readily confirm that the Los Angeles area (or rest of SF) is performing properly. While they may be within the same test area boundary (e.g., a state), testing in a small portion of the test area would not provide adequate confidence in the performance of the entire area. The extent to which this may or may not be the case is network/technology dependent and is left to the body performing the maintenance testing to plan.

Indoor Testing

Accuracy testing under ATIS 0500001 for initial deployment includes requirements for performing a portion of test calls from indoor locations. It is recommended in that document that a good faith estimate of the wireless E9-1-1 calls placed from indoor locations be used. The present document has benefited from and adopts a number of recommendations by the Seventh Network Reliability and Interoperability Council, NRIC VII, that has since emerged. NRIC's current recommendation for indoor testing is 5%. A percentage of test calls consistent with the latest NRIC recommendations (or FCC rules, if any) should be included in the maintenance testing performance analysis. This percentage may be updated from time to time as new information is obtained or requirements refined.

Due to the logistical complexities and potential costs associated with on-going indoor testing, the requirement for indoor testing as part of maintenance testing may be accomplished by any one of the following three options:

1) The specified percentage of test calls within a test area may be conducted from indoor locations;

2) Means similar to predictive modeling may be applied in place of on-going indoor testing whereby the performance of a specified percentage of test calls is based on historical indoor performance within a comparable test area. These baseline indoor observations would have been established either during initial accuracy testing or subsequent incremental/on-going testing. In this option, a weighting factor consistent with the previously observed difference between indoor and outdoor performance in the test area may be applied to the specified percentage of test calls (in lieu of actual indoor testing); or

3) Accuracy consistent with established Phase I performance in the test area may be applied to the specified percentage of test calls.

Predictive Testing in a Maintenance Environment

Predictive Modeling

The use of predictive modeling is allowed if conducted in accordance with the ATIS-0500001: *High Level Requirements for Accuracy Testing Methodologies*, document, and if validated by empiric test data collected from the same test area. Empiric test data may likewise be collected incrementally.

Objective

Describe the applicability of predictive testing for the determination of location finding accuracy in a maintenance environment. Specifically, this section refines the recommendations of ATIS-0500001: *High Level Requirements for Accuracy Testing Methodologies*,
for the use of predictive testing in a maintenance environment.

Limitations of Modeling Tools for Maintenance Testing

A predictive testing tool employed in a maintenance environment shall adhere to the recommendations of ATIS-0500001: *High Level Requirements for Accuracy Testing Methodologies*

As stated in ATIS-0500001: "Predictive modeling tools that are appropriate for use in predicting location accuracy for E9-1-1 Phase II purposes must be capable of modeling the behavior of the location technologies and underlying wireless network for the target area of prediction. The predictive methods shall be able to reflect the physical mechanisms that influence the performance of the location technology or technology combinations in use as well as the dependence they may have on the underlying wireless network."

Tools performing maintenance accuracy testing must be capable of observing variations in accuracy over the maintenance period. As such, predictive testing tools employed in a maintenance environment must also be capable of observing accuracy trends and/or deviations from an established baseline accuracy. While predictive tools can rely on empirical or theoretical modeling techniques or a combination thereof, tools used for maintenance accuracy testing should also allow for the inclusion of empirical performance observations in their accuracy determination.

In the instance of an event-driven maintenance trigger, predictive testing tools must be capable of removing and/or otherwise disregarding pre-event inputs, including performance observations and empirical baseline test results as appropriate. For instance, assumptions that the location finding network is functioning in a steady-state or in a deterministic fashion are suspect following and event-driven maintenance trigger and such assumptions should be avoided by predictive tools until empirical performance observations validate the assumptions. Therefore approaches employing long-term averages would be inappropriate for determining accuracy following an event-driven maintenance trigger until such long-term averages could be validated for the post-event environment.

Analysis and Summary of Results

This section discusses the requirements for data analysis, data summarization, and report creation for E9-1-1 Phase II maintenance testing. Additionally, data analysis tooling requirements are presented. These requirements are consistent with methodologies described in ATIS-0500001: *High Level Requirements for Accuracy Testing Methodologies*, NRIC 7 Focus Group 1A final report (reference Section 1.3(8)) and are consistent with the FCC OET Bulletin 71 guidelines.

Objective

The objective of this section is to define statistically sound and acceptable practices for data processing, data analysis, and summarizing of results from accuracy testing performed during E9-1-1 Phase II maintenance testing.

Data Format

Location fix data and ground truth coordinates used for analysis shall be logged and formatted in units of latitude and longitude using decimal degrees with sufficient decimal places for sub-meter level resolution (e.g., 35.123456, -110.123456). The geodetic reference frame shall be noted (i.e. WGS-84 or more recent.)

Time shall be expressed in hh:mm:ss.(subsecond where available) format and the time reference such as UTC or local time. Mobile identification shall be captured and recorded, which uniquely identifies the handset as it is seen by the wireless network.

Vertical location fix results may be included, but are not required. If included, the vertical result shall be formatted in meters above the reference ellipsoid – also known as "Height Above Ellipsoid (HAE)" – and the reference ellipsoid (i.e. WGS-84) shall be noted. The Class of Service should be recorded where available.

Data Analysis Tools and Software

Data analysis tools include data recording tools and data processing tools. Such tools may be used to automate data analysis and enhance data analysis efficiency. All data tools used in data analysis shall be described and documented as part of any maintenance test plan.

Processing of Test Call Data

During the testing process, all calls shall be documented and classified according to their results.

Failed or Dropped Calls

Any failure to complete a test call or any dropped test calls encountered shall be documented as part of the data summary. Such incidents shall be noted in the resultant report, but not be included as part of the compiled statistics and their associated Phase II results.

Systematic Errors

Systematic errors discovered, as part of maintenance testing should be documented.

Weighting of Data

Weighting of data is a method to take into consideration the likelihood that a wireless 911 call (or any wireless call) will be made from a particular location or set of conditions. OET 71 and ATIS-0500001: *High Level Requirements for Accuracy Testing Methodologies* provide a discussion on this subject. Weighting is authorized for E911 Phase II maintenance testing, within the bounds of the test plan, for the selection of test points or post test analysis, but not both.

Test Area

The test area determined per the requirements of Section 6 shall be documented in the test report.

Accuracy Maintenance Test Evaluation Criteria

For purposes of accuracy maintenance testing, the evaluation criteria will consist of comparing test results gathered during the maintenance period with previously established performance baselines for the area under consideration. Potential problem areas can then be identified by any significant downward trends in performance, based on established expectations. Any significant degradation shall be documented. Corrective action shall be performed and documented. The area of concern shall then be re-tested to verify corrective actions have improved the performance to at least the expected levels.

Test Metrics

The 67 percent and 95 percent accuracy metrics shall be calculated and documented for the entire set of useful data

available as defined in the Useful Life of Data section for the compliance region. Additional metrics may optionally be calculated and reported, and other test areas may optionally be used (as described in the Test Area section).

Data Expiration

Location fix data will usually be generated and collected during the maintenance testing efforts. Incremental location fix data collected as a result of ongoing network changes may be compiled with the current test data, as long as the incremental data is not more than 2 years old and if no other maintenance triggers apply. Reference the Useful Life of Data section.

Contents of the Test Report

There are certain elements of information surrounding maintenance testing which are required to insure that sound engineering practices are met and the results are reproducible. Consequently, the test report shall contain the following information as a minimum:

1. Description of testing objectives.
2. Description of the location technology, BTS vendor or air interface tested.
3. Description of all the elements comprising the Phase II location determination network, including all applicable versions of software loaded on each element where applicable.
4. A geographic description of the test area.
5. Description of test points or test routes selected and used along with the methodology for test point or test route selection. Digital photos of test points or along drive routes may also be included.
6. Description of ground truth/reference location used and ground truth determination methodology (e.g. GPS instrumentation) used.
7. Description of any data acquisition equipment/software and data analysis equipment/software used during the testing sequence.
8. Description of any predictive modeling used to develop location test data. A description of the baseline call data used to validate and verify the model results.
9. Description of test metrics per the Test Metrics section and evaluation criteria.
10. Description of any systematic test errors or latency issues, if applicable.
11. Description of any failed or dropped calls, if applicable.
12. Description of any weighting used and the associated statistical justification.
13. The 67% and 95% location error metrics for of the entire valid data set. Additional statistics may be present as required by the test plan objectives.
14. Description of any remaining problems and a subsequent plan for resolution, such as a retest plan or Phase II location determination changes to rectify issues discovered in the field.

The test report shall be archived on commercially available non-volatile media, such as CD or DVD.

Part 2 Maintenance of End-To-End Functionality Testing

GENERAL TEST REQUIREMENTS

Introduction

This section of the document provides the requirements and procedures for performing maintenance of end-to-end functionality testing of the wireless E9-1-1 Phase 1 and/or Phase 2 system.

Maintenance of end-to-end functionality testing, including field operations testing, ensures that the E9-1-1 capability of the network is not degraded or impaired, especially after changes such as those identified in the Test Methodology section of Part 2. The testing procedures outlined in this section are also useful for diagnostic and repair activities on the E9-1-1 network.

Functionality test triggers

Database changes that have the potential to affect call routing:

- New cell sites
- Re-homes of cell sites from one MSC to another MSC
- Cell site sector changes
- PSAP-initiated routing changes for individual cell sites or groups of cell sites
- Platform software upgrades that have the potential to affect call routing (SVT or random tests)
- Technology overlays (e.g. TDMA to GSM)
- Change MPC/GMLC vendors
- Selective router or trunk group changes

Test methodology

Depending on the maintenance event, one of the following tests will be performed during or immediately after the event to ensure that end-to-end call routing and location data delivery are functioning properly:

- ATIS-0500009: *High Level Requirements for End-to-End Functional Testing*
- Simple Verification Test (SVT) or Random Testing

The following tables show examples of network changes that trigger E9-1-1 testing, the typical testing strategy recommended for each of the triggering events, and helpful comments.

Table 2: Examples of Network Maintenance Changes that Trigger E911 Call Testing Per ATIS-0500009 High Level Requirements for End-to-End Functional Testing

Network Change	Impact on E911	Test Action	Notes
New Cell Site	Would go to default routing if not properly provisioned, thus wouldn't be compliant	Requires PSAP call testing.	See ATIS-0500009 High Level Requirements for End-to-End Functional Testing.
New Cell on Wheels (COWs)	Would go to default routing if not properly provisioned, thus wouldn't be compliant	Requires PSAP call testing.	See ATIS-0500009 High Level Requirements for End-to-End Functional Testing.
Emergency COW (e.g., response to natural disaster)	Same as above	Requires PSAP call testing.	See ATIS-0500009 High Level Requirements for End-to-End Functional Testing.
Re-home Base Station to different MSC	May affect call routing	Requires PSAP call testing.	Note: For CDMA this includes cell site number changes. See ATIS-0500009 High Level Requirements for End-to-End Functional Testing.
Change of sectorization of cell site	May affect call routing	Requires PSAP call testing.	See ATIS-0500009 High Level Requirements for End-to-End Functional Testing.
Changing site information including:			
ESRD, ERN, ESRN, or ICID changes	Call may not route properly	Requires PSAP call testing.	See ATIS-0500009 High Level Requirements for End-to-End Functional Testing.
Cell site relocation (new or same hardware)	May affect accuracy and routing	Requires PSAP call testing.	See ATIS-0500009 High Level Requirements for End-to-End Functional Testing.
E9-1-1 Selective Router and/or E9-1-1 trunk group changes		Requires PSAP call testing.	See ATIS-0500009 High Level Requirements for End-to-End Functional Testing.
MPC/GMLC service provider changes		Requires PSAP call testing.	See ATIS-0500009 High Level Requirements for End-to-End Functional Testing.
Wireless carrier technology overlays or migration (e.g. TDMA to GSM)		Requires PSAP call testing.	See ATIS-0500009 High Level Requirements for End-to-End Functional Testing.

Table 3: Examples of Network Maintenance Changes that Trigger E911 Simple Verification Testing (SVT) or Random Call Testing

LAC changes (GSM only)	May affect call routing	SVT or Random testing	Monitor any KPIs that are produced by the location infrastructure and logs for 72 hours look for bad routing.
Trading Identical Phase 2 Location hardware in field (network-based systems)	May affect Phase 2 completion	SVT or Random testing.	Check each sector.
Phase 2 field hardware physical move (network-based systems)	Possibly off air and/or less accurate	SVT or Random testing	Monitor KPIs and logs for 72 hours.
Software new releases for: • BSC • MSC • SMLC • PDE			
	Normally none	SVTor Random testing.	Monitor KPIs and logs for 72 hours.
	Normally none	SVTor Random testing.	Monitor KPIs and logs for 72 hours.
	Potentially lowered Locations Success Rates	SVTor Random testing.	Monitor KPIs and logs for 72 hours.
MPC/GMLC equipment upgrades		SVT or Random testing.	May involve new ESRKs. Monitor KPIs and logs for 72 hours.
PSAP complaints (e.g. misroutes, low percentage of Phase II responses, partial ALI data)		Start with SVT or Random testing and evaluate to determine is further testing is required.	PSAP complaints need to be documented with examples of failed calls. Complaints need to be within a week of issue.

Table 4: Examples of Network Maintenance Changes That Do Not Require E911 Call Testing

Base station retune	Normally none, but errors could occur	Open vendor ticket	

Changing site information including:
• Site name change
• Site numbering (e.g., C406 becomes A237 in re-home) – for GSM only
• Latitude/ longitude coordinates
• Antenna model, antenna AGL, and azimuth changes
• Receive coaxial path changes
• Phase 2 Location equipment receive path changes
  • GMLC
  • MPC			

	Normally no testing needed		Fine tuning latitude/longitude coordinates; not a cell site move
	Normally does not affect E911 but could affect accuracy		Monitor Key Performance Indicators (KPI)s and check accuracy tests when performed
	Normally none	Following announcement of new release, monitor logs and KPIs.	These are E9-1-1 nodes that affect all sites at the same time.

The Simple Verification Test

The simple verification test is a statistical measurement that determines that there is less than one chance in twenty that there is an outage.

After a network change, the simple verification test can be used to:

- Quickly determine that the emergency services call-handling capability of the network is working.
- In a Phase 1 or Phase 2 E911 service area, quickly establish that service to the PSAPs is working normally.

Table 5: SVT Testing Procedure

Step	Action	Note/Comment
1	On the impacted network node or E9-1-1 equipment node, the carrier selects four (4) cell-site sectors from the list of sites impacted by the software change. The market team identifies which handset technologies (AMPS, CDMA, GSM, TDMA, UMTS) are impacted.	• Be certain that the cell-site selection includes all impacted technologies: AMPS, CDMA, GSM, TDMA, and UMTS. Simulator works with both GSM and UMTS networks. • Test no more than one sector per site.
2	The field tester places an E911 test call from each of the four sample sectors for each handset technology.	Use appropriate handset and/or test device to originate a 911 test-call.
3	Wireless 911 personnel validate that each test call displays the correct 911 information for each level of 911 service tested. If the required number of tested sectors operates correctly and displays the correct information on the PSAP display and/or test tool, the 911 network passes the SVT. Test failure is a non-normal condition to be referred to operations and/or the vendor of the changed node.	Test criteria per impacted network node or E9-1-1 equipment node: • Four successful calls on four randomly selected sectors is a PASS. • If more than one call fails to provide the proper 911 information during the initial four test calls, the test fails. • If only one call fails out of the initial four calls, make four additional calls. If calls five through eight are successful, then the testing is deemed successful. • If any calls in the second set of four fail, the testing is deemed unsuccessful. Consult the SMEs for the impacted network node or E9-1-1 equipment node. If the problem persists and cannot be resolved during the maintenance window, initiate back-out procedures to restore operational functionality and the compliance of the 911 network.

When to use the SVT

The following table identifies major categories for which the SVT is appropriate, and others for which it is not appropriate.

Table 6: When is the SVT the Appropriate Test?

SVT is Appropriate for . . .	SVT is Inappropriate for . . .
• SMLC/SMPC software upgrades • TDOA system software upgrades (WLG) • RNC/BSC software upgrades • SMLC restoration (following an outage) • MSC upgrade or recovery • GMLC software upgrades	• Switch rehome (potentially impacts each sector) • MSC-table changes including LAC-CID and ESRN • GMLC hardware or link changes • ALI trunk changes (must be live-call tested)

Simple Verification Test Limits

The simple verification test is designed to be simple and easily performed in the field by call testers and monitored on a local or remote basis. But, there are important limits to the simple verification test.

Test Assumptions

The simple verification test assumes that the system was working normally prior to the software, hardware, or network change being tested. The following list shows the critical test assumptions:

- The wireless network is a working Phase 1 or Phase 2 market that had been handling Emergency Service calls normally.
- All critical radio access network and CORE E9-1-1 nodes are operational and alarm free.

If testing a Phase 2 network, the location hardware was returning valid Phase 2 response to the serving PSAP prior to the change under test.

Test Considerations

This test is most valuable if an expert can define before hand the probable failure mode of the test and the specific behavior to look for as an indication of success or failure.

The test works best if the first office application (FOA) release or software upgrade to the network is to a single, identifiable E9-1-1 network node, messaging, or communication link.

The test would not give valid results if it were used to determine that the network is behaving normally following multiple changes on the network. If multiple nodes are impacted simultaneously, the test may catch gross outages, but will not catch problems with complex interactions or the failure of links or individual sites. In complex moves it is essential to be aware of both what the SVT tells you and what it doesn't tell you.

The test tells you:

- If the operational condition of the network has changed after the FOA release or software upgrade has been applied
- If the sites are still performing as they performed before the upgrade

The test cannot tell the quality of the service, nor does the test measure anything or provide information about impacts to quality parameters.

Note: The SVT method is based on a statistical quality control method call Bayesian Analysis. The test is designed to confirm that the network is behaving the same way after the software upgrade as it was before the software upgrade. Four (4) successes in four (4) attempts show that the likelihood that the system is different from before is less than 5%. A test criterion of seven (7) successes in eight (8) attempts says the likelihood that the system is performing differently is less that 10%. These constitute acceptable risks. But this test does not check E911 accuracy or provide a true estimate of location completion percentages.

Random Call Testing

Random call testing involves selecting a random number of cell sites in area affected by maintenance that represents approximately 10% of the total cell sites. Perform end- to-end functionality testing on the selected cell sites. If call routing and data delivery is functioning as expected, monitor the KPIs and call logs for approximately 72 hours to ensure functionality is maintained.

DOCUMENTATION OF RESULTS

For scenarios on Table 2, Examples of Network Maintenance Changes that Trigger E911 Call Testing Per ATIS-0500009: *High Level Requirements for End-to-End Functional Testing*, test data and results documenting E9-1-1 Phase 1 and 2 end-to-end functional testing shall be maintained in accordance with sound engineering practice and shall be stored on a standard commercial media.

Test Call Data

During the testing process, all calls shall be documented and classified according to their results.

Failed or Dropped Calls

Any failure to complete a test call or any dropped test calls shall be documented and the test call repeated until a successful result is obtained.

Success criteria

In all cases, except as noted, a successful test results in the caller's callback number, cell

sector (Phase 1) and/or x,y data (Phase 2) being delivered and displayed correctly at the

PSAP. For an end-to-end functional test to be successful, the data received by the PSAP must match the data sent by the wireless network. Character and enumerated values must be delivered without material alterations.

Appendix A Confidence Intervals for Means

A technique that can be applied to predict the adequacy of the size of a certain sample, without making significant assumptions about the underlying distribution, is confidence intervals for means. The distribution at hand is that of the location error. The mean and the variance (standard deviation) are used as surrogates for the distribution in that if they have not changed from prior testing then the distribution is largely unchanged and so are its percentiles, most notably the 67^{th} and 95^{th} percentiles.

The technique of confidence interval for means is used to ascertain, with a given confidence, that a mean of a certain distribution is within a confidence interval of its value observed earlier, provided that the standard deviation is known (i.e., has not changed). This can be applied backwards to determine the minimum size of the sample that provides a result, with the desired level of confidence, that the mean is within the target confidence interval, e.g., that the mean location error is within +/-k% of the previously measured mean.

A fundamental assumption is that the variance (standard deviation) is known. An implicit assumption is that the conditions of the location system (including equipment performance), underlying wireless network (to the extent that it is involved in or affects location determination) and its area under test (i.e., the physical and electromagnetic environment) have not changed from previous testing so that the previous variance remains essentially unchanged.

Another basic statistical assumption is that the sample average μ of a sample of size n is approximately normally distributed, even if the underlying variable itself (e.g., the location error) is not normally distributed. This holds true in general if n is sufficiently large, at least 25 or 30 through the application of the Central Limit Theorem.

The factors that need to be satisfied for this to hold without concern about the exact size of the sample are:

The variable (the location error) is not concentrated at two or three values such as 30, 110 and 250 (e.g., conceivably AGPS, Hybrid and AFLT, or possibly outdoor, in canyon, and indoor across some geographic area). Such a hypothetical example would yield a tri-modal distribution (density function, histogram, etc.)

The distribution is continuous, e.g., it does not have spikes, like 40 percent of the data is at a single value.

Assuming the above fairly easy conditions are satisfied, then the equations for the normal distribution can be applied to the mean error. Accordingly, for 90% confidence, the confidence interval for the sample average μ is given by

$$\mu \pm 1.645 \left[\sigma / \sqrt{n} \right]$$

where σ is the established sample standard deviation (presumably from prior testing). This means that we know with 90% probability that the observed sample average would lie within this interval. Here 1.645 is directly related to 90% of the Normal curve. For 95% confidence that number would be 1.96. The 90% confidence is used below, but the extension is trivial.

If it is desired to estimate μ to within a $\pm$ k fraction (say 20%) of μ it is easy to substitute that into the above equation to get

$$k\mu = 1.645 \left[\sigma / \sqrt{n} \right]$$

which yields

$$n \geq [\, 1.645/k]^2 \bullet [\sigma/\mu]^2$$

For k = 0.2, i.e., 20%, as an example, we have

$$n \geq 67.7\ [\sigma/\mu]^2$$

which verifies, with 90% confidence, that the newly observed mean μ' is within +/- 20% of the value μ observed earlier. For the confidence interval to be within +/-15% of the value of μ, the formula becomes

$$n \geq 120.3\ [\sigma/\mu]^2$$

This increase is sample size is intuitive since a larger sample is required to ensure a more precise mean with the same level of confidence. The percentages of 15% or 20% are arbitrary but reasonable in terms of extent of change from original and the resulting sample size.

A few numerical examples are provided here for illustration. First, if a sample of very well behaved outdoor GPS points was observed with a mean error μ = 30 m and a standard deviation σ = 20 m, and the conditions under which these statistics were observed have been confirmed (by TBD means) to not have changed, then a sample of minimum size n = 31 calls would be adequate to verify, with 90% confidence, that μ' is within 20% of the 30 m observed earlier. If the testing includes areas where AFLT is invoked, e.g., an urban area, and the mean μ observed was 40 m and the standard deviation was 80 m then n = 271. The same approach applies for a network-based system. If the μ observed earlier is 90 m and the standard deviation (which is assumed to not have changed materially) is 125 m, then 131 calls would suffice to verify that μ' is within +/-20% of μ observed earlier.

The above examples are summarized in Table 1.

Table 1. Example Sample Sizes

		Minimum Sample Size n for Different 90% Confidence Intervals	
		+/- 15% of μ	+/-20% of μ
Established Mean μ (meters)	Established Standard Deviation □ (meters)		
30	20	**54**	**31**
40	80	**482**	**271**
90	125	**232**	**131**

Appendix A: 006

(Reproduced here at the request of the WSP)

High Level End-to-End Functionality Testing

ATIS-0500009: *High Level Requirements for End-to-End Functional Testing* is an ATIS standard developed by the following committee(s) under the ATIS User Interface functional group:

The Emergency Services Interconnection Forum (ESIF), Subcommittee G

The complete text of this ESIF document is available, through ATIS

3 GENERAL

3.1 Purpose

The overall goal of end-to-end testing is to assess the level of functionality provided by wireless 911 systems with respect to Federal Communications Commission (FCC) requirements to deliver 911 Automatic Location Identification (ALI) information accurately and within specified time constraints. These suggested procedures verify that the routing PSAP is receiving wireless 911 calls in an appropriate manner. End-to-end testing is not focused on location accuracy performance as compared to FCC accuracy requirements. It is focused instead on the delivery function. Any party wishing to perform Phase 2 accuracy testing should refer to ESIF Technical Report ATIS-0500001,"High Level Requirements for Accuracy Testing Methodologies". The framework contained herein can be used for both End-to-End Functional Testing or in conjunction with Maintenance Testing as defined in ATIS-0500007. This framework can also be used as a reference on how the integrated E9-1-1 architecture performs under different scenarios, with different phones and capabilities, and utilizing different location technologies.

3.2 End-to-End Functional Testing Concept

The objective of End-to-End Functional Testing is to validate call routing and data delivery from each active cell site/sector in the PSAP jurisdiction. In addition to this, optional tests as outlined in Section 4.5 can be executed based upon PSAP requests. End-to-End Functional Testing assumes that this is the WSP's initial attempt to implement either Phase 1 or Phase 2 service over the entire PSAP coverage area or that portion of a PSAP's coverage area served by the wireless carrier. Subsequent testing conducted in conjunction with wireless carrier system expansion (but not a Phase 2 upgrade) is covered under the guidelines for Maintenance Testing referenced above. Figures 3-1 and 3-2 show the high-level network architecture for End-to-End Functional Testing. A carriers' network interconnects to a PSAP CPE via direct trunking or through the LEC Selective Router and the Emergency Services Message Entity (ESME), which contains various LEC or stand alone ALI databases, protocol converters, etc.

Appendix A: 007

High Level Accuracy Testing

ATIS-0500001: *High Level Requirements for Accuracy Testing Methodologies* is an ATIS standard developed by the following committee(s) under the ATIS User Interface functional group:

The Emergency Services Interconnection Forum (ESIF), Subcommittee G

The complete text of this ESIF document is available, through ATIS.

3 GENERAL TEST REQUIREMENTS 2

3.1 Introduction

This section on General Test Requirements serves the following purposes:

1. It lists a set of basic, concise and broad requirements for the methodology addressed in this document to test and validate the accuracy of an E911, Phase II location system as it is implemented in a given wireless service provider's network.

2. It introduces the framework for this methodology, which consists of related, cohesive elements (described in the remaining chapters of this document) that form the basis for the test methodology.

3. It defines the context for the "system under test" to which this methodology is applied. For reference, there is a system diagram for the location network being tested that identifies interface points for accuracy testing within ANSI 41 and GSM MAP networks (Figure 3-2and Figure 3-3).

Appendix A: 008

Testing Definitions

There are a number of definitions regarding various "types" of wireless testing have arisen from discussions at ESIF.

Accuracy Testing
Accuracy testing, whether through empirical and/or predictive test methods, consists of generating location data to gauge the accuracy performance of the system. Location data, typically significant in volume, involves the location infrastructure of the carrier's network. The primary objective is to verify location accuracy and correct any location system errors. Limiting the test to the carrier's location network minimizes impact to the rest of the Phase II network and maximizes the capability of the carriers to optimize their system.

Functionality Testing (End to End)
Functionality testing consists of testing the delivery of the location data from the carrier to the PSAP. The objective of this testing activity is to ensure interoperability between the carrier and the Emergency Service Network. This testing activity requires tight coordination among the involved parties, which normally includes the Emergency Service Network, the carrier and the technology vendors.

Maintenance Testing
Maintenance testing may be conducted after a system has been turned up with the Emergency Service Network. Like all network systems, maintenance testing will be conducted as needed to ensure functionality and performance. This testing activity may include functionality and/or accuracy testing and the participation of the Emergency Service Network may or may not be required. Maintenance testing can be a condensed version of the original accuracy and functionality testing.

Empiric Testing
An empirical location accuracy test consists of measuring the difference between a location established by typical surveying techniques or by a differential GPS receiver or similar means and the location estimate provided by the wireless carrier.

Predictive Testing
A predictive test method consists of utilizing a predictive model to compute the expected accuracy of a location determining technology within a wireless carrier's service area. The predictive model takes into account the physical elements of the location determining system for network or handset based solutions as well as the relevant terrain and RF propagation characteristics

APPENDIX B: 001

Wireless Performance Testing by PSAP

Project LOCATE recommends that every PSAP or AHJ become aware of methods to evaluate the performance of current systems within their service area. It is important to understand the consistency and accuracy of location data delivered with wireless 9-1-1 calls at their PSAP(s). Local testing of system performance need not be elaborate or expensive. Regardless of which local testing plan used, it is important to use the same testing procedures during each testing episode in order to diminish the introduction of any new variable(s), which could modify the results. Good descriptive language about the test call site, weather, structures etc. will also be helpful as the degree of location error is calculated.

Establishing baseline performance parameters from known ground truth points within the service area, both inside and outside of buildings, from moving vehicles, rural and urban environments will provide the basis for at least two forms of action:

- Assessment of the degree of location error the system provides on calls from like points, which can be critical to making effective dispatch decisions;

- Recognition of changes in system performance, which can impact, dispatch decisions and/or may warrant a conversation with the wireless service provider about he degradation of service.

In addition, in cooperation with the WSPs, Project LOCATE has these questions that can be anticipated when reporting a degradation of system performance to a wireless service provider.
At what location are you experiencing the issue (nearest cross street or geo marker)?
When did you first notice the issue?
What experience have you had in the past from this location?
Have you made any changes to your PSAP network system?
Who should we contact for further information if needed?

Local testing plans have been provided as samples.

Wireless Performance Testing by PSAP

SAMPLE Plan Provided by Bexar Metro 911/Bexar County, TX

1.0 INTRODUCTION

The purpose of the District's Wireless Quality Assurance Program is to ensure the successful end-to-end delivery of a 9-1-1 call and locational capabilities originating from all wireless networks serving the San Antonio metropolitan area. The program provides a means for Bexar Metro to gauge the overall operational ability of each wireless 9-1-1 network on a continuing basis. This document focuses on the processes followed by Bexar Metro personnel while conducting the various forms of testing which comprise the wireless quality assurance program. Data collected will be used to validate a carrier's ability to effectively process wireless 9-1-1 traffic, identify service affecting issues, and meet the Phase II accuracy guidelines mandated in FCC 94-102.

Test elements include voice quality, network anomalies, data presentation, and Phase II accuracy. To support these requirements, the program is composed of three sections:

- Data Management
- Performance Testing
- Phase II Accuracy Testing

The process also provides an additional means of training for 9-1-1 call-takers and verifies functionality of not only wireless network elements, but also PSAP 9-1-1 call-handling and Mapped ALI customer premise equipment.

2.0 DATA MANAGEMENT

A Wireless Facility Master File is maintained by the Operations Department. This file identifies each facility by sector with coverage in the Bexar Metro area of responsibility. Information on each cell contains, but is not limited to, cell ID, sector azimuth, site address, jurisdiction, PSAP routing assignment / ESN, sector radius, ESRK range, and ALI record data. This information is updated on weekly basis as warranted by deployments and decommissions. This file is extracted on a monthly basis by GIS personnel and included as a Mapped ALI layer at all PSAPs, giving the PSAPs the ability to search by specific carrier and cell ID. Bexar Metro works diligently with all WSP to ensure the accuracy of information provided. All deployments, sector changes, and decommissions are reflected in the Wireless Facility Master File and coordinated with the respective carriers. All XY coordinates and site addresses provided by the WSPs will be mapped and cross-check for accuracy using the MSAG, GIS address interpolation tool, aerial photography, and field verification.

Staff will conduct a quarterly compare of information contained in the master file with extracts provided by the WSPs and third party database providers. Additionally, an annual routing review of all facilities located in fringe areas will be conducted to ensure annexations, boundary changes, or modifications to PSAP service areas, are adequately reflected in the master and WSP routing tables. This annual audit will be conducted first quarter of each year or as warranted by annexation activity or changes in PSAP service areas.

3.0 PERFORMANCE TESTING

Performance testing is conducted on a continuing basis in conjunction with our Phase II accuracy assessment and in situations where perceived network issues warrant additional investigation of individual cell facilities and sectors. The primary objective of performance testing is to verify the operational capability of each WSP's network through a series of test calls placed from each cell sector. Network issues adversely impacting 9-1-1 services and call quality are documented. Such conditions include blanking, busy signals, voice/transmission degradation, service outages, or the ability of the network to provide accurate Phase II location information.

The following procedures will be followed by personnel when conducting performance testing:

1. Visual inspection of cell site is conducted. Site address and FCC registration number are documented if posted. Cell site location is compared with Bexar Metro base map.
2. XY Coordinate of cell site or entrance to the location is obtained using GPS and documented in the Wireless Facility Master File.

3. A test call will be placed from each sector.

4. The following information will be documented for each sector call placed:

- Answering PSAP
- Callback Number presented in ALI
- Class of Service on Call Answer and Subsequent to Rebid

- ALI Record Format – (Carrier Code, Sector, Site Geo Reference)
- XY Coordinates received at PSAP
- Confidence and Uncertainty

5. Any perceived anomalies or degradations in service will be documented and proved through subsequent testing. Major service affecting issues will be reported immediately to the appropriate WSP.

4.0 PHASE II ACCURACY TESTING

The purpose of Accuracy testing is to verify the typical wireless network architecture meets or exceeds the accuracy requirements as outlined in FCC 94-102. Network-based requirements are 67% of all calls within 100 meters, 95% of calls within 300 meters. Handset requirements are 67% of the calls within 50 meters, 95% of the calls within 150 meters. Two different methodologies are used to verify Phase II accuracy provided by the wireless networks: Fixed Control Testing and Geographic Testing.

4.1 FIXED CONTROL TESTING

Fixed Control Testing is conducted using survey grade monuments to establish "ground truth" control stations. Over 200 United States Geological Survey (USGS) or Texas Department of Transportation (TXDOT) survey monuments provide the control network for this testing methodology.

The following procedures will be followed by personnel when conducting Fixed Control Testing:

Requirements:

- A minimum of one survey grade monument will be tested weekly.
- The tester must actually locate the monument and not assume its location.
- Once located, the tester will position directly on top of the monument and begin placing test calls.
- Tester safety is paramount. Extreme caution should be used in accessing control points on right of ways or high traffic areas, where terrain is questionable, and on private property. Permission to test on private property must be secured before conducting the test.

Test Procedures:

1. Technician will identify a monument to use as a control for the test prior to field deployment.
2. Technician will verify presence of monument once he arrives at location. Technician will set up directly on top of the designated monument and place all test calls from that location. The test will be aborted if a monument cannot be located and absence of monument will be noted in the monument inventory file.
3. Two test calls will be placed on each wireless carrier's network from the control station.
4. Test calls should route to the normal serving PSAP as defined in the Wireless Facility Master File.
5. Technician will verify Phase I and Phase II functionality. To this end the following information will be verified:

    - Serving PSAP
    - Callback Number presented in ALI

- Class of Service on Call Answer and Subsequent to Rebid
- ALI Record Format – (Carrier Code, Sector, Site Geo Reference)
- XY Coordinates received at PSAP
- Confidence / Uncertainty

6. The date of the test, location, and information obtained during the test will be documented and entered in the Wireless Accuracy Testing Database for further review and evaluation.

4.2 GEOGRAPHIC TESTING

Geographic Testing allows the technician to randomly create test scenarios emulating "real world" scenarios. Test calls will be placed from various points within a predefined test area. For the purpose of call tracking and analysis, a grid system comprised of 285 grids as identified in the Mapsco San Antonio Map Book is used to define the test area. A minimum of two distinct test points will be randomly selected within each grid on an annual basis, with each tested a different time period within the calendar year. The ground truth for all test points will be established using a Trimble AG-114 Differential GPS (D-GPS) receiver certified as accurate within 3.28 feet 90% of the time. The receiver is pre-set to prevent the technician from logging a control point if the Position Dilution of Precision (PDOP) exceeds 4 or fewer than 5 satellites are in view.

The following procedures will be followed by personnel when conducting Geographic Testing:

Requirements:

- On average, a minimum of 20 control points will be tested weekly.
- Each test point must be randomly selected within the confines of the established test grid.
- Tester safety is paramount. Extreme caution should be used in accessing control points on right of ways or high traffic areas, where terrain is questionable, or on private property. Permission to test on private property must be secured before conducting the test.

Test Procedures:

nt on the Phase II accuracy results obtained for each WSP's network during Fixed Control and Geographic Testing. The results are expressed as a percentage and can be viewed on a monthly, yearly, or total project perspective.

7.0 TROUBLE REPORTING

All anomalies or service degradations will be documented and reported to the Director of Operations or Deputy Director of Operations on a daily basis. Service issues impacting wireless call delivery, such as network failures, degradations in Phase II accuracy, Phase 0 translations, or call routing issues will be reported immediately to the appropriate WSP network operations center, third party database provider, or local WSP engineering group.

The following information must be documented for each case of trouble encountered:

- Wireless Network
- Cell Site Number / Sector
- Time of Call
- Date of Call
- Phone number of test instrument
- ESRK
- Description of trouble encountered

Technician should refer to the District's Operations Escalation list for the appropriate wireless or network points of contact for reporting purposes.

Bexar Metro 9-1-1 Network District
WIRELESS QUALITY ASSURANCE
Testing Methods and Procedures Document
Revised November 2006

APPENDIX B: 002

Wireless Performance Testing by PSAP

SAMPLE Testing Plan submitted by Tarrant County, Texas for evaluating the performance of, as well as accuracy of data delivered to their PSAP(s) as a sample as well. **Phase 2 Call Testing**

Objective of Phase 2 Call Testing

The objective of this round of Phase 2 testing is to determine if the wireless carrier is meeting the FCC mandate for accuracy.

WSP X, WSP Y and WSP Z are using the network solution – 67% within 100 meters and 90% within 300 meters.

WSP A, WSP B and WSP C are using the handset solution – 67 % within 50 meters and 90% within 150 meters.

We will issue a report card for each of the 6 major carrier in each of the 2 categories stating the actual % of calls in each of the 2 mandates.

For example:

WSP X delivered 72% of calls tested within 100 meters.
WSP X delivered 93% of calls tested within 300 meters.

In addition, a map detailing results (color coded) for each of the carrier's test sites will be provided.

Methods and Procedures for Phase 2 Call Testing

Geographically diverse test sites

The base map of the territory covered by Tarrant County 9-1-1 District consists of 159 MAPSCO grids. There will be at least 2 test sites per MAPSCO grid. This will provide a base of at least 318 geographically diverse test sites.

Number of test calls per carrier

We will make 2 calls from each carrier's phone at each of the 318 test sites. This will provide a base of at least 636 test calls per carrier.

Since WSP Y and WSP Z have 2 networks (TDMA and GSM), we will provide a base of at least 636 test calls for each carrier's TDMA network and at least 636 test calls for each carrier's GSM network.

Location of caller at each test site

The call tester will be standing at the corner of an intersection.

A later round of call testing will be conducted from various "environments" such as inside a building, inside a car and in an urban canyon. These results will be compared to the base line results established by this round of testing.

Measuring the deviation distance

The measurement tool in the mapped ALI display at the PSAP is used to determine the accuracy of the location.

Since the caller will always be located at an intersection, one point of measurement will be the intersection.

The other point of measurement will be icon on the map.

The measurement tool displays the number meters to 2 decimal places.

All measurements will be rounded to the nearest whole meter.

Time between initial call delivery and 1st re-bid

The tester in the PSAP will wait at least 15 seconds before a re-bid is launched.

Number of re-bids per test call

Every test call will consist of the initial call delivery to the PSAP and one re-bid.

If the distance deviation is over (fail) the FCC mandate after one re-bid a second re-bid will be made and the data recorded.

If the second re-bid "passes" the call, it will be recorded as a pass.

Determining Pass/Fail for each call

Every location will be given a +/- 10 meter halo to account for the fact that the call tester is standing at the corner instead of the middle of the intersection.

Locations that are within the +/- 10 meter halo are considered "conditional" data points.

Locations that are not within the +/- 10 meter halo are considered "absolute" data points.

There are 4 possible "grades" for each call:

- AP = Absolute Pass
- CP = Conditional Pass
- CF = Conditional Fail
- AF = Absolute Fail

For the 50 meter goal:

- 0 – 40 m = AP
- 41 – 50 m = CP
- 51 – 60 m = CF
- 61 + m = AF

For the 100 meter goal:

- 0 – 90 m = AP
- 91 – 100 m = CP
- 101 – 110 m = CF
- 111 + m = AF

For the 50 meter goal:

- 0 – 140 m = AP
- 141 – 150 m = CP
- 151 – 160 m = CF
- 161 + m = AF

For the 50 meter goal:

- 0 – 290 m = AP
- 291 – 300 m = CP
- 301 – 310 m = CF
- 311 + m = AF

Absolute data points only will be used to determine the overall grade of the carrier in meeting the FCC mandates for location accuracy.

January, 2007 Courtesy of Tarrant County 9-1-1

APPENDIX B: 003

Wireless Testing by PSAP and WSP

Project LOCATE provides a sample testing plan and agreement between a AHJ and the WSPs for testing. The primary purpose of such plans, although they need not be elaborate, is to discuss and mutually agree on the expectations of each other as well as the method by which review will be possible.

CSEC Wireless Phase I & II E9-1-1

PSAP Testing Procedures
And
Notification and Certification of Service

Purpose

The purpose of this document is to provide guidance to 9-1-1 Entities, WSP and third party vendors in the provisioning of Wireless E9-1-1 Phase I & Phase II service throughout the State of Texas by establishing notification policies, testing procedures, and certification documentation requirements.

In preparation for wireless deployment, the Commission on State Emergency Communications (CSEC) has designed procedures and spreadsheets for use by you and your PSAPs for wireless testing. As all 9-1-1 professionals are aware, testing and certification are critically important in all new service deployments. These procedures may be tailored to better suit the needs of the individual regions. We appreciate your assistance in insuring that wireless Phase I & II E9-1-1 service is deployed accurately and efficiently.

Scheduling and Notification

The following information will be utilized in defining **new deployment** and **maintenance** when determining testing and documentation requirements of Wireless E9-1-1 Phase I & Phase II service.

New Deployment: Initial deployment of wireless cell sites that occurs when a wireless service provider has not previously deployed in a PSAP jurisdiction within the 9-1-1 Entity's region. For example, if a carrier has deployed in one PSAP within a county – like

the Sheriff's Office – but not the others, and later adds towers within one of the cities. This would be a new deployment because the carrier was not previously deployed within that city.

Maintenance: Maintenance occurs when a wireless service provider has already deployed E9-1-1 cell sites within a PSAP jurisdiction, and then adds a new cell site (or sites) or temporary cell site within that PSAP jurisdiction. For example, the carrier is already deployed and certified in a county, but they increase the number of towers in that county. This would be considered maintenance because the carrier is already providing Phase I service in that area.

Testing Notification Procedures:

Wireless testing should be scheduled through the COG on behalf of each PSAP, by each of the WSP in your region. All scheduling is subject to the specific needs of each region and each wireless carrier. Testing schedules and arrangements should be mutually agreed upon in advance so that the proper notifications and preparation of all affected parties can be made. Advance paperwork must include a Testing Validation Worksheet (TVW). If no TVW is made available at time of scheduling, a TVW must be received from the WSP five working days in advance of approved – scheduled test date.

We request that you notify CSEC of any testing that is scheduled so that we can keep current on wireless deployment activities across the state, and facilitate in any way necessary.

Due to the nature of wireless networks and testing, it may not always be possible for a COG to have personnel at each PSAP, for each test call, for all carriers. The COG will probably need to rely upon calltakers or other PSAP personnel to assist with verification of call routing and data delivered by the wireless carrier. This is completely acceptable as long as the basic testing procedures are followed by the COG/PSAP, and the criteria are met by the wireless carriers. These procedures and related spreadsheets have been designed with this in mind.

Wireless Testing

There are two phases of new deployment wireless testing: profile testing and field-testing. These are separate tests and will usually occur at separately scheduled times.

Profile Testing - is *preliminary* testing that occurs prior to any field-testing, and is designed to test the different call scenarios and variables that may occur with wireless calls. ***No documentation is needed for profile testing.*** This type of testing confirms that the wireless carriers' mobile switching center (MSC) is routing correctly through the designated 9-1-1 tandem. This level of testing also allows the PSAP to verify that there are no CPE or screen format problems related to wireless calls.

Field Testing – verifies that calls made from each cell site and cell sector are routed correctly to the designated PSAP, that the callback number is delivered and displayed correctly on the CPE, that the correct and accurate cell site/sector data is provided along with the call, and for Phase II the X, Y coordinates of the caller are delivered.

Spreadsheet models for each type of testing are provided.

- The top portion of each spreadsheet should be completed by the COG and will provide basic information about the test.

- The Site ID and Site Address fields should be completed by the wireless carrier since this will provide identical information to both the wireless carrier personnel and the PSAP against which to verify location, routing and data delivery.
    - CSEC recommends that the COG request this information from the carrier upon receiving a notification to test.

- CSEC recommends that the COG provide these spreadsheets to the carrier electronically so that the carrier can populate these fields well in advance of the testing dates, providing the COG adequate time to distribute this information to the affected PSAPs.
- It is also completely acceptable for COGs & PSAPs to use validation worksheets provided by the wireless carriers as long as the format used contains the required information. Many carriers have these spreadsheets readily available and this alternative is simpler and faster in many instances.

Field Testing

For each cell site and sector, the carrier will need to test and verify the following: routing, call back number, and location information. This will be accomplished through dialogue between the wireless carrier field personnel and the PSAP personnel, reading off and confirming data and information to each other. ***The success or failure for each cell site and sector should be recorded on the attached spreadsheet.*** The following scenarios and information must be tested:

- Site Address – address of the cell site location
- Sector Orientation and Number – cell sector directional information and number, i.e. 1, 2, 3, or "ALL" if an omni tower
- Correct Screen Format – verify that call back number and location information display in the correct CPE screen format field
- Designated PSAP - populated by the wireless carrier, and previously designated by the COG, as the PSAP to which calls originating from that particular cell site/sector should be delivered
- PSAP Routed to During Test – verification by the PSAP that the call was routed to the appropriate designated PSAP
- Call Back Number (CBN) – verification that the call back number was delivered and displayed appropriate to the CPE screen format, and that the correct call back number was delivered.
- For Phase II verify that the class of service came in "WRLS" not "MOBL", and then after the rebid it changed to "WPH2". CSEC is not certifying the accuracy of Phase II calls; accuracy is being certified by the carriers prior to the deployment.

Maintenance Site Testing

The WSP should notify the 9-1-1 entity in advance of the actual maintenance 9-1-1 testing. Documentation will be provided to the 9-1-1 Entity with proposed routing and addressing information. The data will be provisioned as shown on the documentation. The 9-1-1 Entity will revise the received TVW if required. The data will be updated as specified by the 9-1-1 Entity on the revised TVW. If the 9-1-1 Entity does not respond with revisions to the TVW *within 10 working days*, no changes will be made to the data as originally provisioned and as shown on the original TVW (or equivalent). The WSP should verify via e-mail within three business days (of its submission of TVW) that the 9-1-1 Entity has received the TVW. The email should include a reminder of the 10-day deadline. When the 9-1-1 Entity responds with revisions, it should clearly communicate the acceptance of all other data on the TVW. If the 9-1-1 Entity does not respond with revisions to the TVW, the WSP can turn up Phase I service and notify the RPC as soon as possible after the turn-up.

Notice of Certification and Deployment

CSEC requires that the COG notify us, formally and in writing, upon the successful testing and deployment of new wireless service for each wireless carrier that provides wireless Phase I or Phase II E9-1-1 service in the region. CSEC does not require documentation for maintenance testing. Based upon recommendation of the State Auditor's report, CSEC requires that PSAP validated TVWs be submitted in conjunction with this notification. If a PSAP validated TVW is not available, the screen prints for each sector of each tower must also be sent to CSEC.

CSEC suggests that the COG also provide a copy of this notification to the wireless carrier as certification of acceptance of the testing and subsequent service. Attached you will find a "Certification Letter" that has been developed for use by the CAPCO region for these purposes. CSEC recommends this format as a "Best Practice" model for other regional councils to adapt and utilize for the same purposes. Should there be any cell sites/sectors that failed the testing criteria, retesting will be required until they are successful in meeting the requirements. Notification and certification should include the following information at a minimum:

- Acceptance and documentation of successful Field Testing for each cell site and sector, and delivery of call back number (See attached CSEC Wireless Deployment Documentation Acceptance Criteria)
- Itemization of each county in which wireless Phase I E9-1-1 service was deployed
- The population of each county in which this service was deployed
- A list of each PSAP successfully receiving wireless 9-1-1 calls

CSEC appreciates your assistance with this important matter. If you should have questions or comments regarding wireless testing, or these procedures, please contact the following:

See Also Documentation Criteria – Next Page

Wireless Deployment Documentation - Acceptance Criteria

_____	_____
RPC	Wireless Carrier
_____	_____
County	PSAP

Wireless Documentation must meet the following requirements in order to be certified to the CSEC and the carrier as tested and deployed. BOTH notification & certification AND field-testing documentation MUST be submitted to be accepted.

_____ **Notification & Certification Letter from the COG, should include the following information:**

_____ Carrier Name

_____ Number of Cell Sites Tested

_____ Number of Cell Sectors Tested (not required)

_____ Total number of cell site sectors routed correctly

_____ Total number of cell site sectors unsuccessfully routed

_____ Overall Percent Successful

_____ List of unsuccessful routing, and request for retest

_____ County Name

_____ County Population (according to Texas State Data Center)

_____ PSAP Name

_____ Date of Implementation

_____ **Field Testing Documentation should consist of:**

_____ PSAP Validated Field Testing Worksheet
These should clearly demonstrate that the PSAP personnel physically received calls from the wireless carrier to validate each cell site and sector listed on the spreadsheet.

-OR-

_____ Carrier-provided Field Testing Worksheets

AND

_____ **PSAP Screen Print Outs to Validate**
This data should clearly substantiate carrier results.

APPENDIX C: 001

Wireless 9-1-1 Deployment Assistance

Project LOCATE, as part of a separate wireless deployment information and training program, has developed the "Deployment Handbook." This self-assessment tool allows any AHJ or specific PSAP to evaluate current needs and readiness for effectively participating as an informed partner with any WSP in maximizing deployment within the service area.

In addition, a sample Memorandum of Understanding (MOU) enumerating the responsibilities of the public safety entity as well as the Wireless Service Provider and others is provided.

1 Deployment Toolkit Summary Handbook: http://www.locatemodelcities.org/documents/Handbook0806.pdf

ENHANCED 9-1-1
MEMORANDUM OF UNDERSTANDING
Between _____and_____

WIRELESS CARRIER RESPONSIBILITIES
It shall be WSP's responsibility, in cooperation with 9-1-1 Governmental Entity and necessary third parties (including, but not limited to, Vendor, 9-1-1 Network Provider, Host ALI Provider, SCP software developers and hardware providers, and other suppliers and manufacturers), to implement and provide Phase __ E9-1-1 Service to 9-1-1 Governmental Entity in the agreed upon manner within the Phase __ E9-1-1 Service Areas. This shall include the following:

a) participating in network design

b) causing its network elements (such as the MSC and related data links and trunks) to be installed

c) operating, maintaining and provisioning these network elements

d) facilitating or participating in the development of an implementation plan which will establish target dates for actions necessary for installation and activation of E9-1-1 Service

e) acquiring necessary software and equipment

f) entering into necessary interconnection agreements for interconnecting the MSC to Selective Routers and, if necessary, for interconnecting the SCP

j) Coordinating or participating in the adds, changes and deletions of database records in appropriate databases, including, but not limited to ALI Host database and Selective Router

k) providing initial Cell Site/Sector Information and updates as they occur.

9-1-1 GOVERNMENTAL ENTITY RESPONSIBILITIES

It shall be 9-1-1 Governmental Entity's responsibility to work with WSP and, where necessary, with third parties (including, but not limited to, Vendor, 9-1-1 Provider/LEC, Host ALI Provider, SCP software developers and hardware providers, and other suppliers and manufacturers) for the successful implementation and provision of Phase __ E9-1-1 Service. This shall include the following:

a) validating 9-1-1 Governmental Entity Jurisdiction map boundaries

b) participating in the development of an implementation plan which will establish target dates for actions necessary for installation and Activation of E9-1-1 Service

c) providing and verifying needed data about each PSAP's existing infrastructure and any other information necessary for successful installation, maintenance and provision of E9-1-1 Service

d) informing third-party vendors, such as Computer Aided Dispatch (CAD) providers, of data to be delivered with 9-1-1 calls for coordination with PSAP premise-based systems

e) augmenting the trunks, when necessary, as agreed upon by Parties, between a selective router and any PSAP

f) ensure that all PSAP premises equipment is equipped to receive E9-1-1 voice and data services

g) informing WSP of any 9-1-1 Governmental Entity system changes that may affect E9-1-1 Service

h) provide that necessary changes, modifications and/or updates are made with respect to the ALI Database for successful receipt of ALI Host Records

i) supporting all testing/verification activities to be undertaken by WSP, or Vendor or third party, if applicable, in relation to this MOU

j) participating in the creation of a trouble reporting mechanism and associated trouble resolution process

k) cooperate in testing, troubleshooting, modifications and other activities necessary to the implementation and continued operation of the E9-1-1 Service

Target Deployment Date:_____

WIRELESS CARRIER CONTACTS:

E9-1-1 Service Deployment Contact Name & Number:_____

E9-1-1 Service Deployment Vendor (If appl.):_____

Wireless Carrier Testing Contact Name & Number:_____

Wireless Carrier 24 x 7 Security Number:_____

Post-Deployment Trouble Reporting:_____

9-1-1 GOVERMENTAL ENTITY CONTACTS:

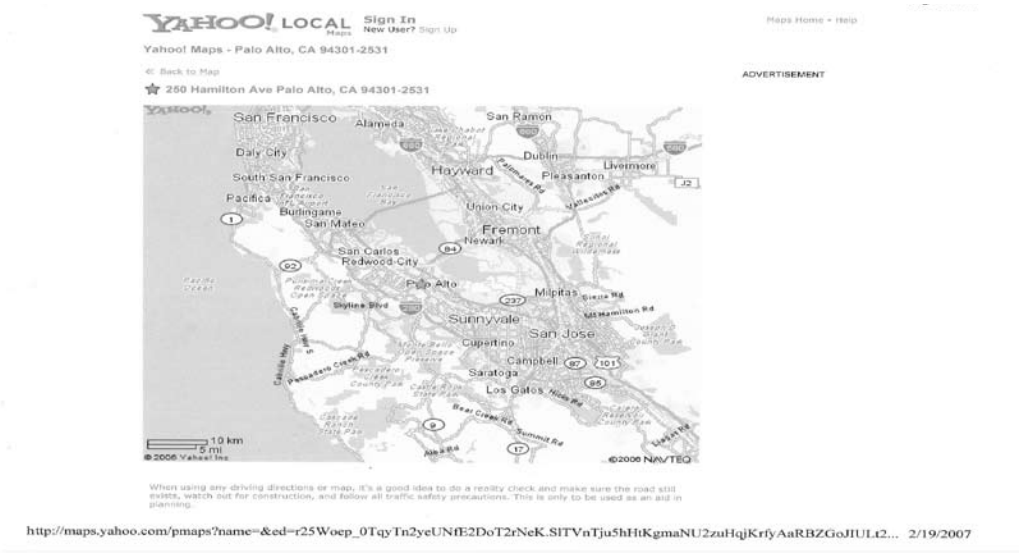
E9-1-1 Service Deployment Contact Name & Number:_____

Deployment Testing Contact Name & Number:_____

Government Auth. 24 x 7 Contact Name & Number:_____

APPENDIX C: 002

PSAP Test Areas
Wireless Accuracy Test Area Summary
Palo Alto, CA



PSAP Test Area Summary

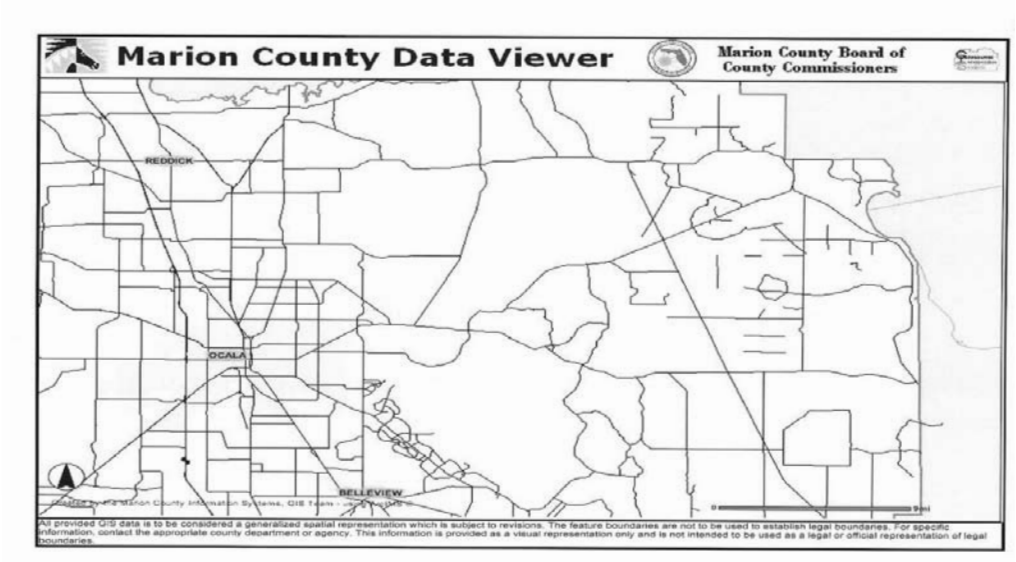
Located 35 miles south of San Francisco and 14 miles north of San Jose, Palo Alto is a community of approximately 61,200 residents. Part of the San Francisco Metropolitan Bay Area and the Silicon Valley, Palo Alto is located within Santa Clara County and borders San Mateo County. The City's boundaries extend from San Francisco Bay on the east to the Skyline Ridge of the coastal mountains on the west. The City encompasses an area of approximately 26 square miles and is strategically located and easily accessible to major surface routes, including Interstate 280, Highway 101, Highway 84 - the Dumbarton Bridge and Highway 92 - the Hayward-San Mateo Bridge

Name of Agency: Palo Alto Police Department
275 Forest Ave, Palo Alto, CA 94301
LOCATE Contact Person: Charles Cullen
Service Population: 150,000
911 System Service Provider: SBC
Customer Premise Equipment:

1. **Telephony: Motorola Centralink**
2. **Computer Aided Dispatch: PSSI**
3. **Mapping Utilization Solution: City GIS Application**

Average annual 9-1-1 Calls and percent of which are wireless:
25,000 50% wireless
Wireless Phase II deployed by: Nextel, Verizon, Cingular, Sprint, T-Mobile and Metro PCS

PSAP Data a used in Test Area Selection Process, Fall, 2005
Ocala/Marion County, Florida



PSAP Test Area Summary

Ocala/Marion County in Florida boasts a unique mixture of rural and urban lifestyles within its boundaries. Our rolling hills and majestic tree-lined scenic country roads are a surprise to many first time visitors. Centrally located in the very Heart of Florida, there is easy access and almost equal distance to the Gulf of Mexico and the Atlantic Ocean. The county is divided by Interstate Highway 75 N/S and State Road 40 E/W, both serving as daily transit routes as well as emergency evacuation routes.

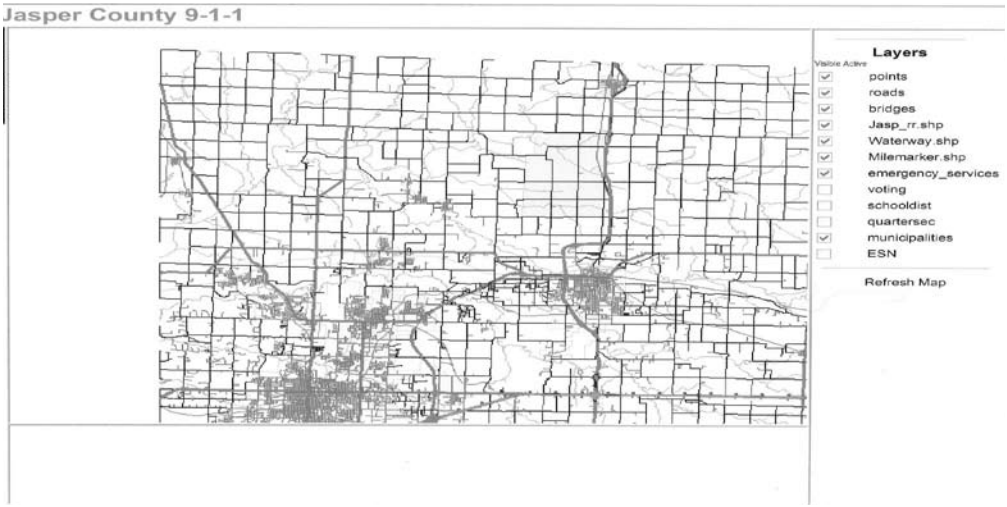
Name of Agency: Marion County 9-1-1 Communications
Two PSAPS: Marion County Sheriff's Department
City of Ocala Police Department
LOCATE Contact Person: Dick Nelson, Director
Service Population: Est. 600,000 – 750,000
911 System Service Provider: Sprint
Customer Premise Equipment:

1. **Telephony: Plant Equipment**
2. **Computer Aided Dispatch: Per Agency**
3. **Mapping Utilization Solution: Mapped ALI, MARS-VESTA w/Orion MapStar**

Average annual 9-1-1 Calls and percent of which are wireless:
200,000 47% wireless
Wireless Phase II deployed by: Cingular, Alltel, Sprint, Verizon,
Nextel, T-Mobile

PSAP Data as used in Test Area Selection Process, Fall, 2005

Jasper County, Missouri



PSAP Test Area Summary

Jasper County, Missouri is located in Southwest Missouri, shares a common border with Kansas, Oklahoma is minutes away and Arkansas is less than an hour. The County is crossed by Interstate Highways 44 (E/W and 71 N/S). The resident population reported as 110,624 in 2005, is diversely settled over the 640 square miles within the county borders.

Name of Agency: Jasper County Emergency Services Board
13870 Dispatch Ln. Carthage, MO 64836
LOCATE Contact Person: Ronald Boyer, Executive Director
Service Population: 350,000
911 System Service Provider: SBC
Customer Premise Equipment:

1. **Telephony: Nortel Meridian**
2. **Computer Aided Dispatch: Intergraph**
3. **Mapping Utilization Solution: ESRI, Intergraph**

Average annual 9-1-1 Calls and percent of which are wireless:
32,000 70% Wireless
Wireless Phase II deployed by: AT&T, Cingular, Sprint, T-Mobile
US Cellular (in progress)

PSAP Data as used in Test Area Selection Process, Fall, 2005

Syracuse, NY

PSAP Test Area Summary

The County of Onondaga is located in the central New York region, has a land area of 793.5 square miles and is approximately 35 miles in length and 30 miles in width. The resident population is nearly 500,000. Onondaga County is the home to Syracuse University, home of the Carrier Dome and LeMoyne College. The County serves as the crossroads of New York State, bisected by the New York State Thruway and US Route 81. The topology of the county is flat in the northern half of the county and hilly in the southern half of the county.

Name of Agency: Onondaga County 9-1-1 Communications Control Center
3911 Central Ave., Syracuse, NY 13215

LOCATE Contact Person: Stephen J. Wisely, Commissioner

Service Population: 750,000

911 System Service Provider: Verizon

Customer Premise Equipment:

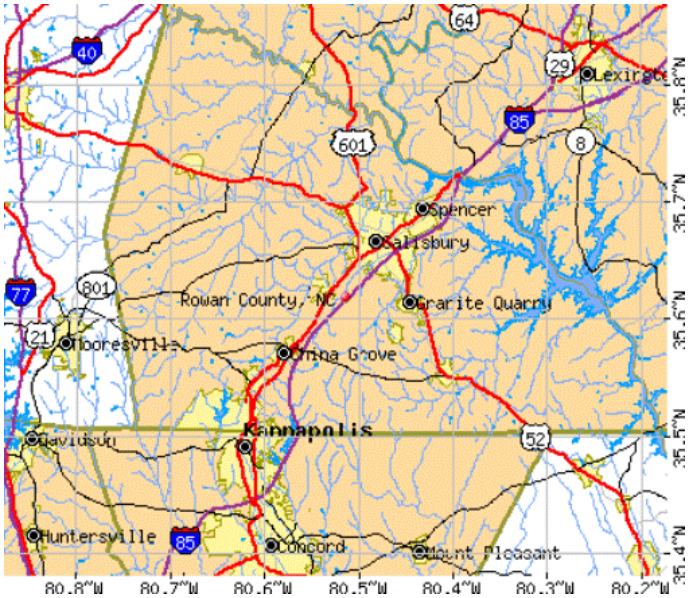
1. **Telephony: Plant Vesta**
2. **Computer Aided Dispatch: PRC**
3. **Mapping Utilization Solution: Mapped ALI – Orion MapStar**

Average annual 9-1-1 Calls and percent of which are wireless:
650,000 50% wireless

Wireless Phase II deployed by: AT&T/Cingular, T-Mobile, Nextel Partners, Sprint, Verizon Wireless, Cricket

PSAP Data as used in Test Area Selection Process, Fall, 2005

Rowan County



PSAP Test Area Summary

Rowan County is one of 100 counties in North Carolina. The county is in the Salisbury metro area and had an estimated population in 2004 of 134,317 living within a total area of 524 square miles.

Name of Agency: Rowan County 9-1-1
232 N. Main St. Suite 202
Salisbury, NC 28144

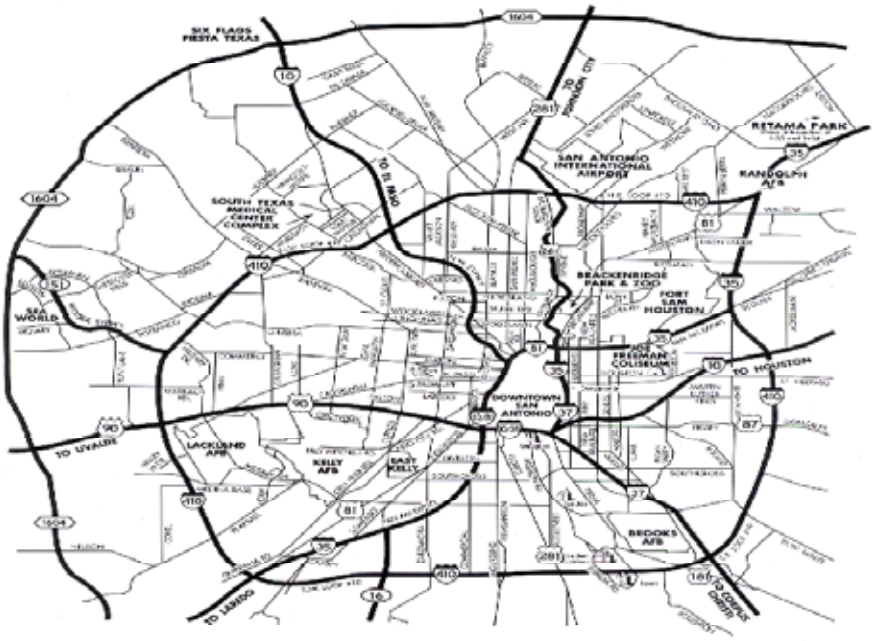
LOCATE Contact Person: Frank Thomason and Rob Robinson
Service Population: 140,000
911 System Service Provider: BellSouth
Customer Premise Equipment: Positron

1. **Telephony:**
2. **Computer Aided Dispatch**
3. **Mapping Utilization Solution Mapped ALI**

Average annual 9-1-1 Calls and % wireless:
130,000 dispatched calls / 35% wireless
Wireless Phase II deployed by: Verizon, Sprint, Nextel, AT&T/Cingular, Sun Telecom, Alltel, Cricket

PSAP Data as used in Test Area Selection Process, Fall, 2005

Bexar County, TX



PSAP Test Area Summary

Bexar County is located in South Central Texas. The county seat of Bexar County, and it's largest city, is San Antonio. Bexar County takes up an area of 1,248 square miles. The estimated population in 2004 was 1,493,965. _

Name of Agency: Bexar Metro 9-1-1 Network District - Bexar County Sheriff

Bexar County was Primary Test Area

203 W Nueva, RM 309, SAN ANTONIO, TX 78204

LOCATE Contact Person: Brett Schneider

Service Population: 1.4 Million in entire 9-1-1 District

911 System Service Provider: SBC

Customer Premise Equipment

1. **Telephony: Positron Power911**
2. **Computer Aided Dispatch: Hybrid System - Agency**
3. **Mapping Utilization Solution: Positron PowerMap**

Average annual 9-1-1 Calls and percent of which are wireless:

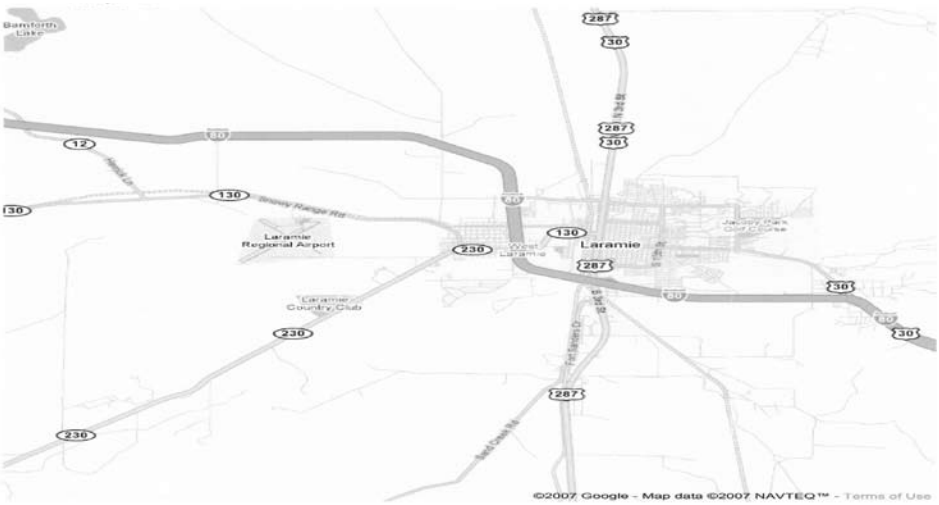
Bexar County Sheriff – 56,308 55%

Wireless Phase II deployed by: Cingular (Orange and Blue Networks)

Sprint, Nextel, T-Mobile, Verizon

PSAP Data as used in Test Area Selection Process, Fall, 2005

Laramie, WY.



PSAP Test Area Summary

Laramie is the county seat of Albany County. At 7165 feet, Laramie is nestled in the Southeast corner of the still "unsettled" State of Wyoming. The city is near the intersections of I-80 and I-25 and houses the University of Wyoming. The Laramie Mountains span along the eastern county line.

Name of Agency: Laramie Police Department

42 Ivinson Ave., Laramie, WY. 82070

LOCATE Contact Person: Cmdr: Dale A. Stalder

Service Population: 32,000 exclusive of tourists and interstate travelers

911 System Service Provider: Qwest

Customer Premise Equipment:

1. **Telephony: Motorola CentraLink**
2. **Computer Aided Dispatch: Sungard H.T.E.**
3. **Mapping Utilization Solution: Positron PowerMap**

Average annual 9-1-1 Calls and percent of which are wireless:

12,000 ave. 55% wireless

Wireless Phase II deployed by: Verizon, Alltel, Sprint PCS

4. **Mapping Utilization Solution: Positron PowerMap**

Average annual 9-1-1 Calls and percent of which are wireless: 12,000, running between 48 and 64% monthly from wireless

Wireless Phase II deployed by: Cingular/AT&T, AllTel, Nextel, Sprint PCS, Verizon, Cricket

PSAP Data as used in Test Area Selection Process, Fall, 2005